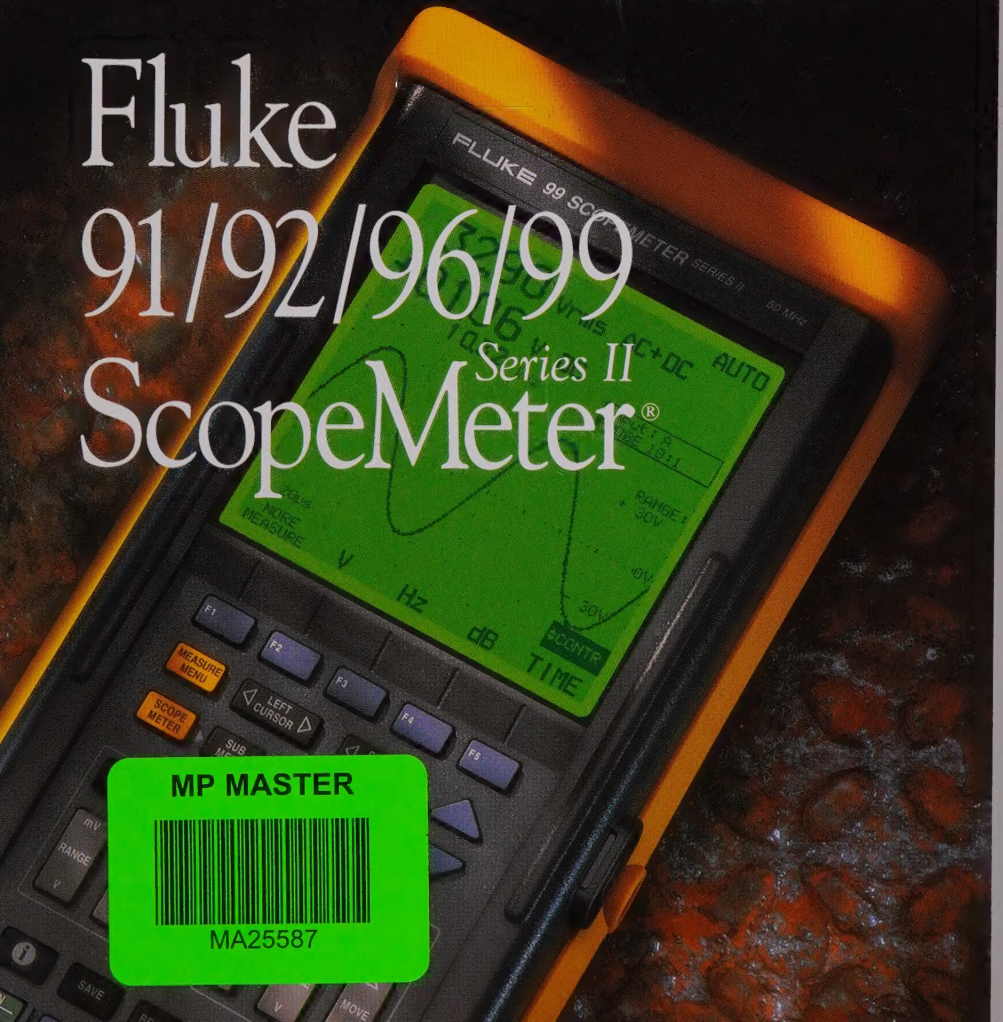
# Fluke 91/92/96/99 Series II ScopeMeter®




MP MASTER
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Users Manual

FLUKE®

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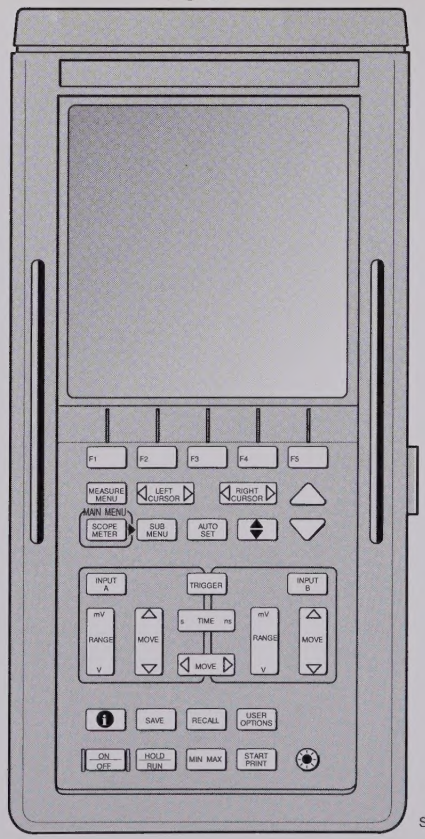


ST7445

92 & 91

# Fluke 91/92/96/99 Series II ScopeMeter®

*Users Manual*

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FLUKE®

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## ABOUT THIS MANUAL

### Chapter 1 Introducing the ScopeMeter® Test Tool

This chapter introduces features and capabilities of your ScopeMeter test tool.

### Chapter 2 Getting Started

This chapter provides a 15-minute demonstration intended for those who are not familiar with the ScopeMeter test tool.

### Chapter 3 Making Measurements

This chapter explores all measurements and specifies the use of the direct Measure Menu key. At any time, you can choose over 30 measurements to get an immediate reading on the display.

### Chapter 4 Using the Dual Display Mode

This chapter addresses the use of four Dual Display Mode Functions of the ScopeMeter test tool: METER, Ω, ⊣⊢, and EXT.mV. You will learn how to set up the test tool for ac and dc voltage measurements, diode tests, resistance measurements, and trend plotting. Chapter 5 contains all the Scope mode information.

### Chapter 5 Using the Scope Mode

This chapter explores the specific use of the test tool as a digital storage oscilloscope. You will learn how to make, store, and compare measurements.

### Chapter 6 Using Additional Capabilities

This chapter explores the additional capabilities available with your ScopeMeter test tool. The chapter covers subjects, such as Scope measurements using the cursors, saving and recalling screens, waveforms, or setups, and making a hard copy on your printer.

### Chapter 7 Measuring Examples

This chapter outlines step-by-step procedures necessary to make some typical measurements.

### Chapter 8 ScopeMeter Test Tool Tutorial

This chapter looks at special capabilities of your ScopeMeter test tool. You will become familiar with all aspects by using the demonstration board.

### Chapter 9 User Maintenance

This chapter describes the cleaning of the ScopeMeter test tool and proper use and replacement of the battery pack. Periodic probe calibration is also covered here.

**Chapter 10 Appendixes**

A. Specifications: Operating characteristics.

B. Parts and Accessories: Model numbers and replacement codes for all parts and accessories delivered with your ScopeMeter test tool.

C. PM8907 Power Adapter/ Battery Charger.

D. Advised Printer Setup Parameters: How to set up your printer.

E. Warranty Information and Service Centers: Warranty terms and Service Center addresses.

F. Terminology: Glossary of special terms.

G. Menu Map: Graphic view of the various menus.

**Index**

The index at the end of the manual lists words alphabetically. Consult this list to find an item quickly.

*NOTE*

*Throughout this manual an X trough a model number (~~91~~) indicates that the function being discussed does not apply to that specific model number.*

## UNPACKING THE SCOPEMETER TEST TOOL KIT

The following items should be included in your ScopeMeter® test tool kit (see Figure 1):

1 ScopeMeter test tool

2 NiCad Battery Pack, PM9086/001 (installed)

3 Quick Operating Guide (inside Holster)

4 Yellow Holster, PM9083/001

5 Users Manual (this book)

6 Accessory Case, C75

7 Set of Two Probes, PM8918 (inside Accessory Case), or
Single Scope Probe PM8918, (inside Accessory Case) for Fluke 91.

8 Set of Two Industrial Alligator Clips for Scope Probes, PM9084/001 (inside Accessory Case)

9 Probe Accessory Set, includes:
- HF Adapters (2 x black)
- High Voltage Test Pins (red and grey)
- Banana to BNC Adapter
- Probe Tip to Banana Adapters (red and grey)
- Mini Test Hooks (red and grey)
- Trim Screwdrivers (red and grey)

10 Power Adapter/Battery Charger, PM8907/00x

11 Multimeter Test Lead Set, includes:
- Test Leads (red and black)
- Industrial Test Probes (red and black)
- Industrial Alligator Clip (black)
- Banana Adapters (red and black)

12 Demonstration board with 9V battery

Fluke 91 includes the red and black probe items of the test tool kit only.

Check the contents of the ScopeMeter test tool kit for completeness. If something in the kit has been damaged or is missing, contact your distributor or the nearest FLUKE sales or service office immediately.

## Important

**When new, the rechargeable NiCad battery pack is not fully charged. See Chapter 1 for battery charging information.**

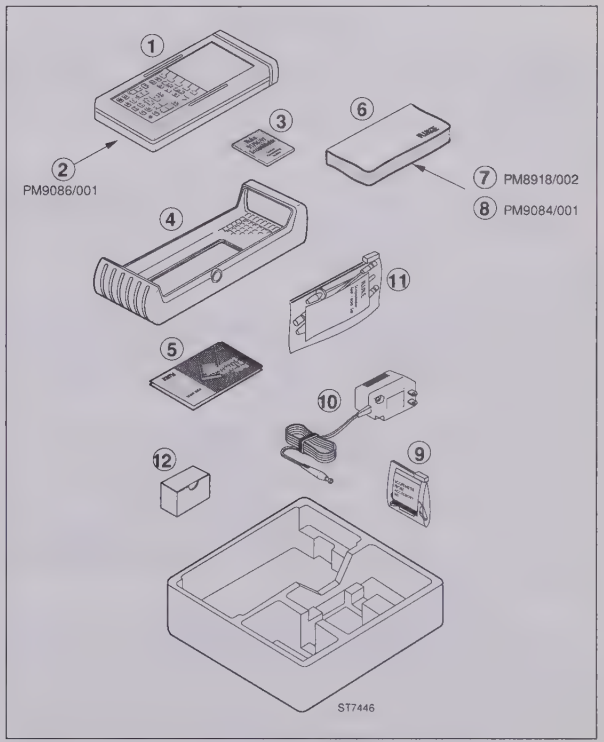


*Figure 1 ScopeMeter Test Tool Kit*

## WARNING

**READ "SAFETY" CAREFULLY BEFORE USING YOUR SCOPEMETER TEST TOOL.**

## SAFETY

The instrument described in this manual is designed to be used only by qualified personnel.

### Safety Precautions

To use this instrument safely, it is essential that operating and servicing personnel follow both generally accepted safety procedures and the safety precautions specified in this manual.
Specific warning and caution statements, where they apply, will be found throughout the manual.
Where necessary, the warning and caution statements and/or symbols are marked on the instrument.

**A CAUTION identifies conditions and actions that may damage the test tool.**

**A WARNING IDENTIFIES CONDITIONS AND ACTIONS THAT POSE HAZARD(S) TO THE USER.**

International electrical symbols used are explained below.

| | | | |
|---|---|---|---|
| | Caution (see explanation in manual) | | DOUBLE INSULATION (Protection Class) |
| | Common (Lo) input symbol, equal potential | | Recycling symbol |
| | High BNC input symbol | | DC-Direct Current |
| | Earth | | AC-Alternating Current |

The terms "Isolated" or "Electrically floating" are used in this manual to indicate a measurement in which the ScopeMeter test tool COM (common, also called ground) is connected to a voltage different from earth ground. The term "Grounded" is used in this manual to indicate a measurement in which the ScopeMeter test tool COM (common) is connected to an earth ground potential.

The ScopeMeter test tool COM (common) inputs (red INPUT A BNC shield, grey INPUT B BNC shield, and black 4-mm banana jack) are connected internally via self-recovering fault protection. The input connectors have no exposed metal and are fully insulated to protect against electrical shock. The black 4-mm banana jack COM (common) can be connected to a voltage above earth ground for isolated (electrically floating) measurements and is rated up to 600V rms above earth ground.

The Fluke 92, 96, and 99 use a three-lead connection system for dual input, isolated (electrically floating) measurements. The connections for isolated and grounded measurements are shown in the following illustration.

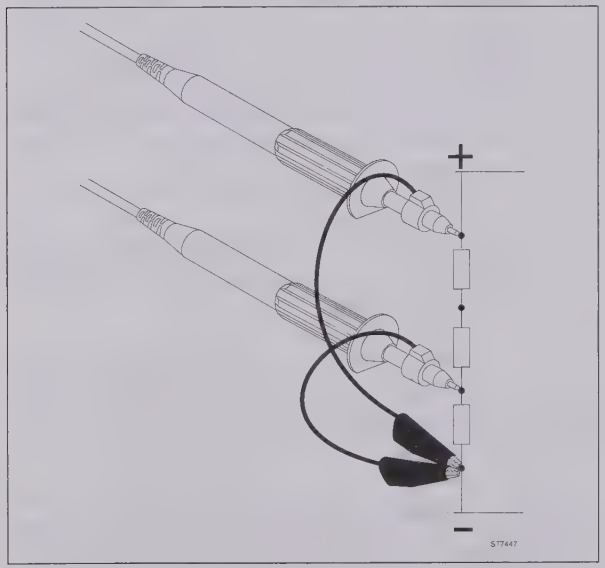


*Figure 2 Common (Ground) Connections for Fluke 92, 96, and 99*

*NOTE*

*Fluke 91 has a two lead connection system.*

**⚠ WARNING**

**DO THE FOLLOWING TO AVOID ELECTRICAL SHOCK IF A SCOPEMETER TEST TOOL ⏚ COM (COMMON) INPUT IS CONNECTED TO >42V PEAK (30V RMS):**

1. **USE ONLY THE TEST LEAD/PROBE SET SUPPLIED WITH THE SCOPEMETER TEST TOOL (OR SAFETY-DESIGNED EQUIVALENTS WITHOUT EXPOSED METAL CONNECTORS).**

2. **DO NOT USE CONVENTIONAL EXPOSED METAL BNC OR BANANA PLUG CONNECTORS IF THE ⏚ COM (COMMON) IS >42V PEAK (30V RMS).**

3. **USE ONLY ONE ⏚ COM (COMMON) CONNECTION (THE 4-MM BLACK BANANA JACK).**

4. **REMOVE ALL PROBES AND TEST LEADS THAT ARE NOT IN USE.**

5. **USE 600V RATED PROBE TIP ADAPTERS. "600V" IS PRINTED ON EQUIPMENT SO RATED.**

6. **CONNECT THE PM8907 POWER ADAPTER TO THE AC OUTLET BEFORE CONNECTION TO THE SCOPEMETER TEST TOOL.**

**If Safety-Protection is Impaired**

**Use of equipment in a manner not specified may impair the protection provided by the equipment. Before use, inspect probes for mechanical damage and replace damaged probes!**

Whenever it is likely that safety has been impaired, the instrument must be turned off and disconnected from line power. The matter should then be referred to qualified personnel. Safety is likely to be impaired if, for example, the instrument fails to perform the intended measurements or shows visible damage.

## MAKING ISOLATED MEASUREMENTS

**Isolating from Earth Ground**

The ScopeMeter test tool uses a three-lead connection system for dual input, isolated (electrically floating) measurements. Use a test lead connected to the black 4-mm banana jack as common ground.

There are only three wires to connect for dual input isolated ground operation, useful for three-phase industrial voltage measurements. You can connect the three leads on the test tool (INPUT A, INPUT B, and common) to a three-phase electrical power line in any order. Use the A-B mode (see Chapter 5) to display all three phases of electrical power at the same time.

For three-phase electrical or other isolated ground industrial measurements, we strongly recommend that you use the black Industrial Alligator Clip and the red and grey Industrial Probe Alligator Clips (see Figure 4). These parts are included with original purchase ScopeMeter test tools and are also available as accessories from your FLUKE representative.

**Isolating from Input to Input**

The ScopeMeter test tool is not isolated between inputs but uses the black 4-mm banana jack for measurements isolated from earth ground.

Complete isolation between INPUT A and INPUT B is useful for some floating measurement applications, such as measuring different isolated transformer windings at the same time.

For those applications requiring true isolated grounds (commons) between inputs, we recommend that you make two separate measurements or use two ScopeMeter test tools.

## PREPARING TO USE THE DEMONSTRATION (DEMO) BOARD

A Demo Board with 9V battery is included in your ScopeMeter test tool kit. It generates different types of waveforms that can be measured at test points TP1 to TP5. All descriptions and measurement examples refer to a waveform that can be measured on the Demo Board.
Do not connect the Demo Board yet, but when you make measurements, do the following:

- Place the Demo Board on a non-conductive surface.
- Connect the 9-volt battery, and make sure that polarity is correct.

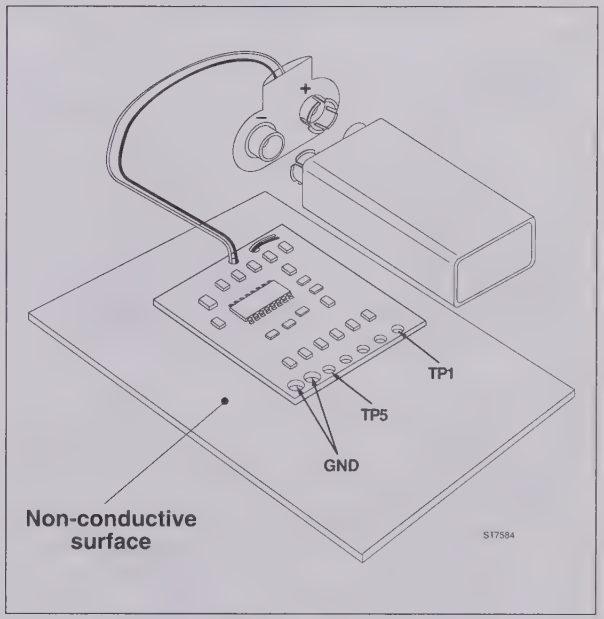


*Figure 3 Demo Board*

The displays and measurements shown in this manual are typical. They will vary depending on the condition of the Demo Board battery.

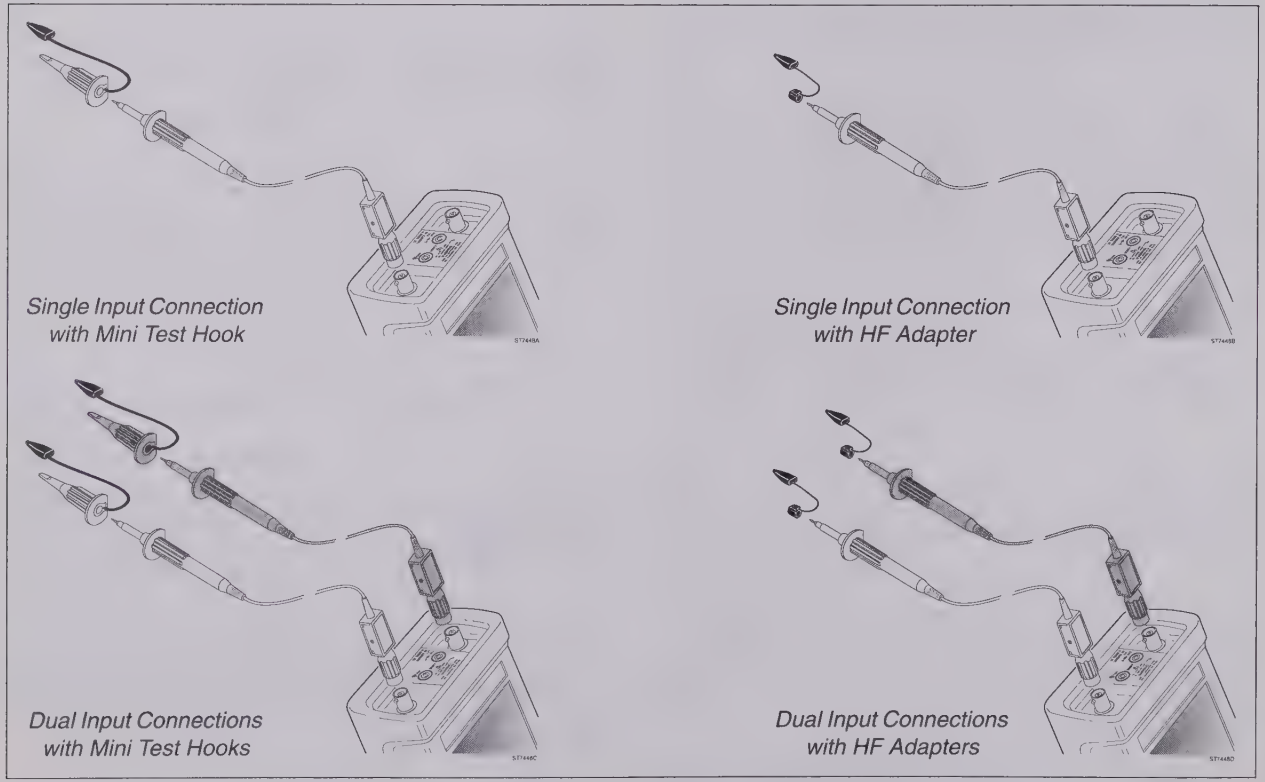


*Figure 4 Input Connections for High Frequency Electronic Measurement*

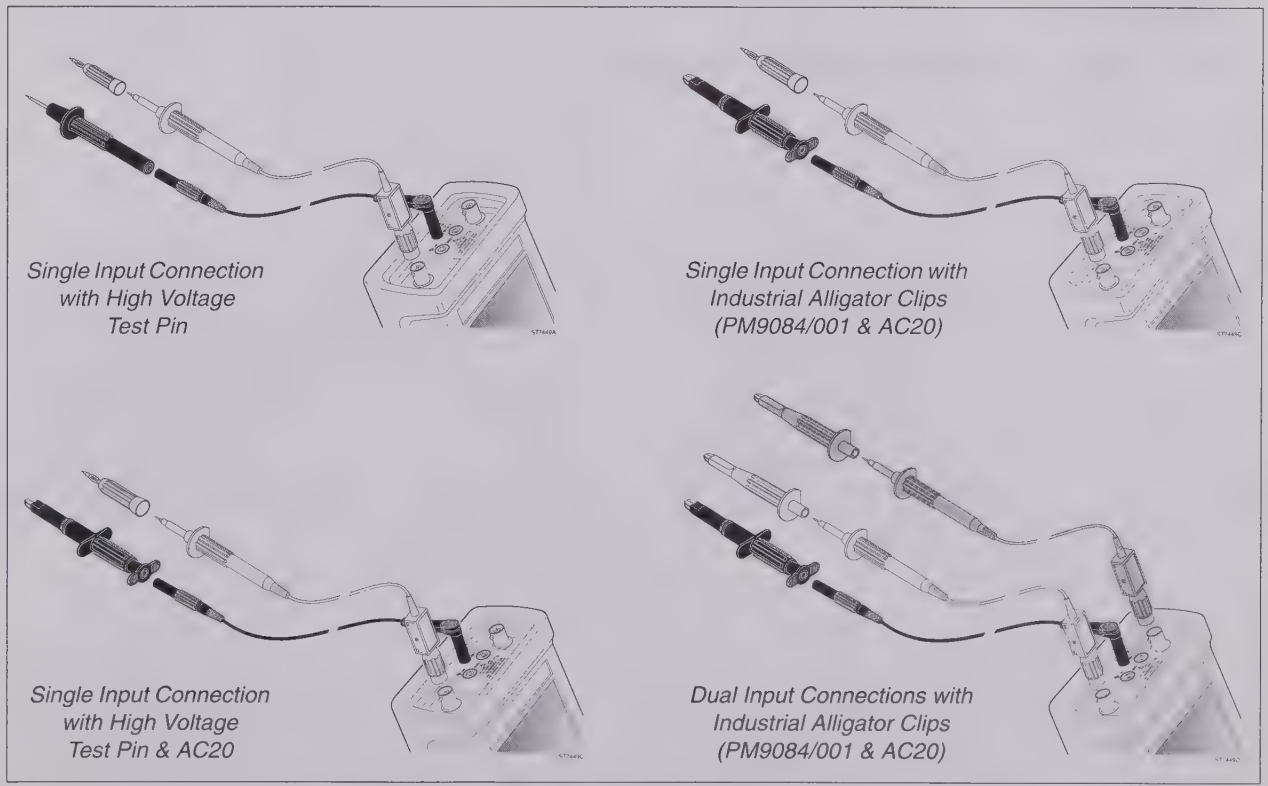


*Figure 5 Input Connections for Isolated Heavy Duty Industrial Measurements*

# Chapter 1
# Introducing your ScopeMeter® Test Tool


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## SCOPEMETER TEST TOOL FEATURES

Your ScopeMeter test tool combines the capabilities of an easy-to-use digital storage oscilloscope with the versatility of a digital multimeter. When you select a measurement function, the test tool automatically chooses the best setup to analyze and compare complex waveforms, or simply to read voltage levels.

ScopeMeter test tool features include:

- 50-MHz Bandwidth Digital Storage Oscilloscope.
- $3\,^{2}/_{3}$-digit, 5-MHz Digital MultiMeter (DMM).
- Battery power.
- Measure menu for quick setup.
- Continuous Auto Set™ function for hands-off signal probing.
- Large memory for front panel Setups, Waveforms, and Screens.
- Min Max TrendPlot™ function with time stamp for long term recording.
- Optical to RS-232 interface port, 600V isolation.
- Instant Information key.

## USING THE HOLSTER AND THE TILT STAND

The ScopeMeter test tool is cradled in a yellow holster that provides shock protection during rough handling. All keys and connections are accessible with the holster in place. You will need to remove the holster only to replace the batteries or access the Quick Operating Guide. (See Chapter 9 for battery replacement instructions.)

The test tool is also equipped with a multiposition tilt stand, allowing viewing from different angles. The stand can also be used to hang the test tool at a convenient viewing position. Simply push up on the quick release and tilt the stand. The tilt stand/bracket is fully usable with the yellow holster in place. Typical positions are shown in Figure 1-1.

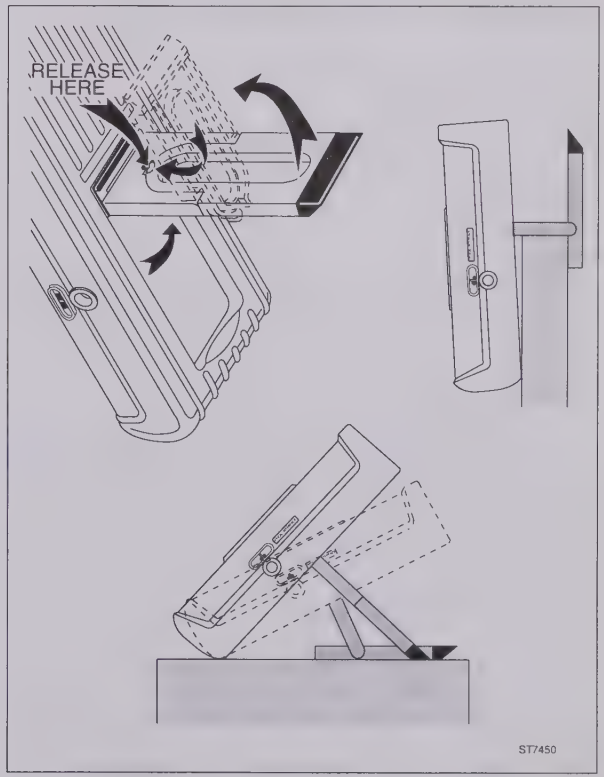



*Figure 1-1 Multiposition Stand*

## POWERING THE SCOPEMETER TEST TOOL

The test tool can be powered from any of the following sources. Refer to Figure 1-2.

- Internal Battery Pack (PM9086/001)
  A rechargeable NiCad Battery Pack comes installed in every test tool.

- C Cell Batteries
  You can use four alkaline batteries in place of the NiCad Battery Pack. (The charger is defeated when standard C cells are installed).

- Power Adapter (PM8907)
  The Power Adapter/Battery Charger powers the test tool from a standard ac outlet. The test tool can be used during battery charging. Verify that your local line voltage is appropriate before using the Power Adapter/Battery Charger to power the test tool and/or charge the battery pack.

  See Appendix 10C for more information.

- Automotive Adapter (PM9087/002, optional)
  The Automotive Adapter powers and charges from a standard 12V dc automotive accessory (lighter) outlet.

Refer to Chapter 9 for battery replacement instructions.

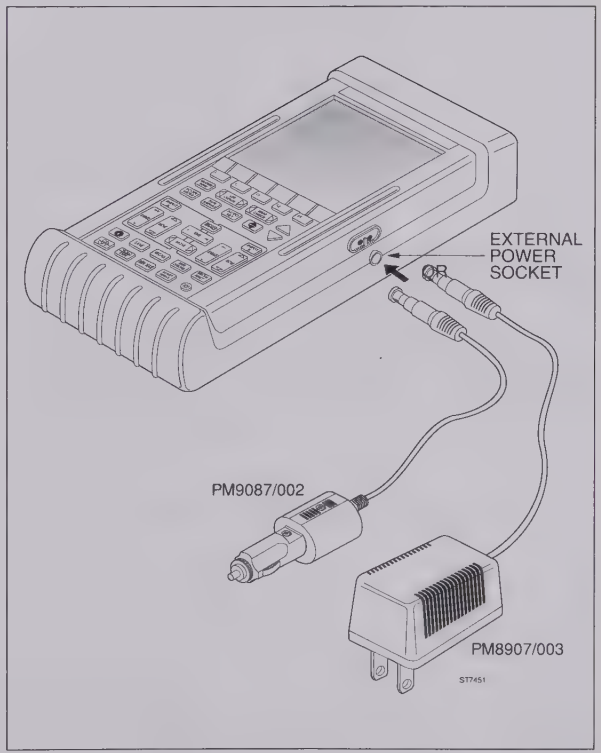



*Figure 1-2 Power Connections*

## MINIMIZING SIGNAL NOISE

In general, using your test tool on battery power only will minimize noise pickup. Using the 10:1 probe will help in noise rejection.

If you use the Power Adapter (PM8907), connect a test lead from the black 4-mm banana jack COM (common) to the measurement common (ground) of the system under test. This technique reduces or eliminates any power line related noise.

## CHARGING THE BATTERY

### ⚠ WARNING

**TO AVOID ELECTRICAL SHOCK, USE ONLY A BATTERY CHARGER THAT IS AUTHORIZED FOR USE WITH SCOPEMETER TEST TOOL.**

Use the following procedure to charge the battery pack and power the instrument:

1. Connect the Power Adapter/Battery Charger to line voltage.

2. Insert the Power Adapter/Battery Charger low voltage plug into the Power Adapter connector of the ScopeMeter test tool. The test tool can now be used while the NiCad batteries charge slowly. If the test tool is turned off, the batteries charge more quickly.

   During operation, when the batteries are low, a blinking battery symbol appears on the top right of the display. When this occurs there is typically more than 30 minutes of operating time left.

3. The Power Adapter/Battery Charger uses a trickle charge for the batteries, so no damage can occur if you leave it charging for long periods, e.g., through the weekend. Typically a 16-hour recharge provides 4 hours of use.

### Saving Battery Life

When operated only on batteries, the test tool conserves power by shutting itself down. If no new keys have been pressed for 5 minutes or if the battery level is too low, the test tool beeps and displays a message. This prompts you to turn off the test tool or to continue. If no key is pressed during the next 5 minutes, the test tool turns itself off automatically.

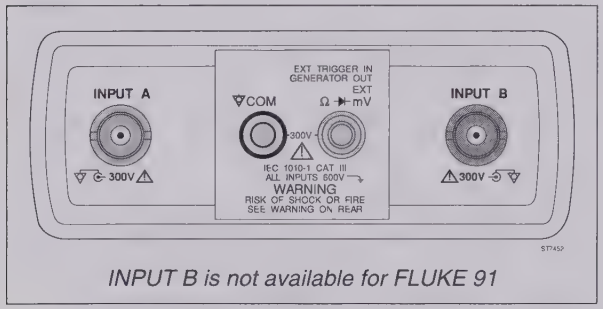
When the ON OFF is pressed ON, the last configuration prior to the automatic shutdown will be restored.

Automatic power shutdown will not occur if Min Max is on or if any key is pressed. Although recording will continue if the batteries are low, memory retention is not jeopardized.

If the POWER ADAPTER is connected, there is no automatic power shutdown.

## LOOKING AT ALL MEASUREMENT CONNECTIONS

The ScopeMeter test tool provides four signal connection points: two safety BNC jack inputs (red INPUT A and grey INPUT B ~~91~~) and two safety 4-mm banana jack inputs (COM and Ω ⊣⊢ **EXT.mV**). This arrangement is shown in Figure 1-3. All connections are positioned within a protective recess at the top of the instrument. The banana jacks are also used as Waveform Generator Output. ~~91~~ ~~92~~ ~~96~~




*INPUT B is not available for FLUKE 91*

*Figure 1-3 Measurement Connections*

In **SCOPE** mode, you can use the red INPUT A BNC jack and the grey INPUT B BNC jack ~~91~~ as input.
In **METER** mode, only the red INPUT A BNC jack is used as input.
In Ω, ⊣⊢, and **EXT.mV** modes, use the red and black 4-mm banana jacks.

For low frequency measurements (up to about 2 MHz), ground can be connected to the black 4-mm banana jack. For higher frequencies you must use the HF Adapter or Mini Testhook on the probe.

The red 4-mm banana jack also serves as an input connection for an external trigger in Scope mode or as an output connection for the waveform generator. This waveform generator can provide voltage or current output.

### Common Ground, Inputs A B ~~91~~

The test tool uses a three-lead connection system for dual input, isolated (electrically floating) measurements.

### Input/Output Terminal Ratings

Maximum voltage ratings are defined near the related terminal. Refer to the Specifications in Appendix 10A for complete terminal rating information.

### RS-232 Optical Interface Connection

The Optically Isolated RS-232 Adapter/Cable (PM9080/001) can be connected to the test tool for printer output and computer interface. The following table shows the printing and communication features for each model:

| | 91 | 92 | 96 | 99 |
|---|---|---|---|---|
| Screen dump using application software | ● | ● | ● | ● |
| Direct output to printer | | | ● | ● |
| Remote control via computer interface | | | | ● |

The adapter and application software are optional.

## READING THE DISPLAY

The display provides a great deal of information. The major part of the display is always devoted to meter readings or the scope waveform. A Dual display appears in **METER**, Ω, ⊣⊢, and **EXT.mV** modes, and is divided into two areas: Main display and Bottom display. A Scope display appears in **SCOPE** mode, and is divided into three areas: Top display, Main display, and Bottom display.

Refer to Figure 1-4 during the following discussions.

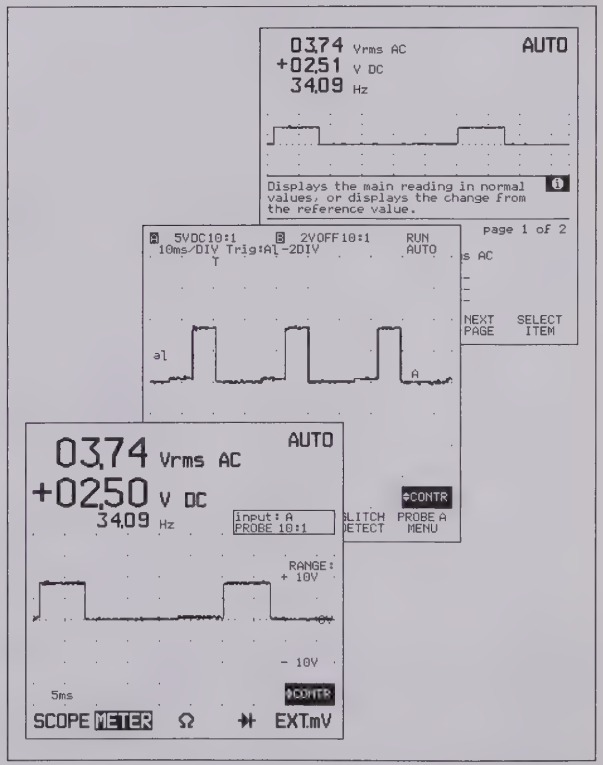



*Figure 1-4 ScopeMeter Test Tool Display*

### Reading a Dual Display

Main Display: Displays the numeric readings combined with a full screen-width waveform display.

Bottom Display: Displays the menu that provides choices available through the function keys and shows which are active.

### Reading a Scope Display

Top Display: Identifies the voltage range, type of signal coupling, selected probe type for INPUT A and INPUT B, time scale, trigger source, and trigger slope. The top right area displays the present status of the test tool, AUTO, MANUAL, RUN, HOLD, etc.

Main Display: Displays the actual or stored waveforms (Scope mode).

Bottom Display: Displays the menu that provides choices available through the function keys and shows which are active.

### Reading a Window Display

When you change a setup, a part of the Main display area is used for a window. It displays choices accessed with the related function key from which you make a selection by pressing F5 (SELECT ITEM). The waveform area is compressed to about 50% (amplitude) size, and the window replaces the bottom half of the Main display.

## USING THE KEYS

*Figure 1-5 The Keypad*

The keys with a predefined function, regardless of the test tool's mode, are called keys or hard keys. Usally they give access to a menu, where items can be selected.

The two yellow keys [MEASURE MENU] and [SCOPE METER] provide the possible ways to find your measurement.

[MEASURE MENU] gives immediate access to a list of measurements. When you choose a measurement, the test tool automatically selects the related main mode.

[SCOPE METER] gives access to the Main menu. Here you can choose from the five main modes: SCOPE, METER, Ω, ⊣⊢, and EXT.mV. Pressing [SUB MENU] gives you more control over the selected main mode.

Figure 1-6 shows the basic navigation of the test tool.

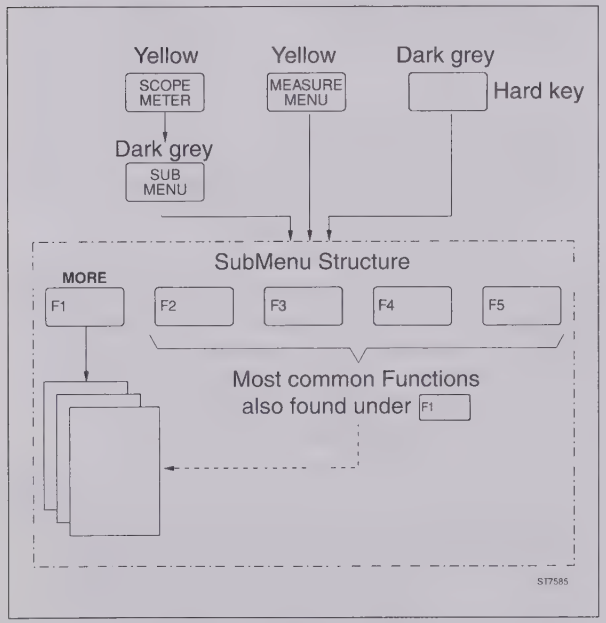



*Figure 1-6 Basic Navigation*

The five blue keys F1, F2, F3, F4, and F5 are called function keys. These keys change function based on the present active menu. Actual function key definitions appear on the bottom display. Function keys and windows work together to provide a complete menu-driven user interface.

F1 is the MORE function key, which opens the window assigned to the key.
When you press the Submenu key for any main function, the F2, F3, F4, and F5 keys allow immediate access to the more common functions that are also under the F1 (MORE function key).

The △ ▽ keys are used to choose an item in a box, or directly from the window. These keys are indicated by two arrows.

## STEPPING THROUGH A WINDOW

When a window appears, the assignments to the function keys change as follows:
F1 is the 'CLOSE' key, which closes the active window.
F2 is the 'CANCEL' key, which ignores changed selections and closes the active window.
F5 is the 'SELECT ITEM' key, which opens and closes a list box and selects the highlighted item.

Stepping through a window has a fixed sequence as shown in Figure 1-7.

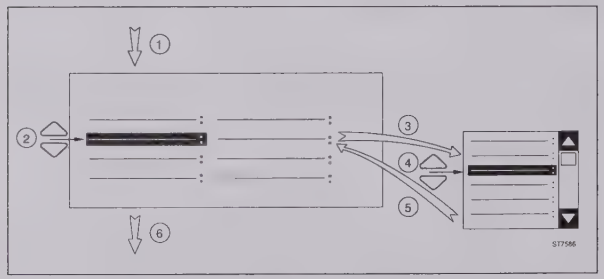



*Figure 1-7 Sequence to Go Through a Window*

The fixed sequence is as follows:

① F1 Press a MORE function key. This opens a window.

(Press F4 (NEXT PAGE) or F3 (PREVIOUS PAGE) to choose an item on page 2 or page 3.)

② ▲ or ▼ Choose the item that has to be changed.

③ F5 Open the list box.

④ ▲ or ▼ Choose the new parameter.

⑤ F5 This selects the new parameter and closes the list box.

Repeat steps ② through ⑤ for more items.

⑥ F1 Close the window and continue measurements.

## USING ON-LINE INFORMATION

You can get information about functions at any time by pressing [ⓘ]. The short descriptions will help you understand how the test tool functions.

When you operate the ScopeMeter test tool, the display provides information about the present condition or explains procedures taking place and asks for confirmation. These messages are always displayed in a box.

More information is available by pressing [ⓘ]. This displays one or more pages of extended on-line information. More information is available under the following conditions:

- In a menu (F1 to F5) you always can get information on the functions for every function key.
- In a window you can get more information about the highlighted function when the ⓘ icon is displayed.
- In a message you can get more information about the conflict with the present setup when the ⓘ icon is displayed. If necessary, the test tool asks for confirmation and disables the conflicting situation.

Figure 1-8 hows an example of a "function info" screen.

You can set the help level for on-line information to high or low. This is explained in Chapter 6.

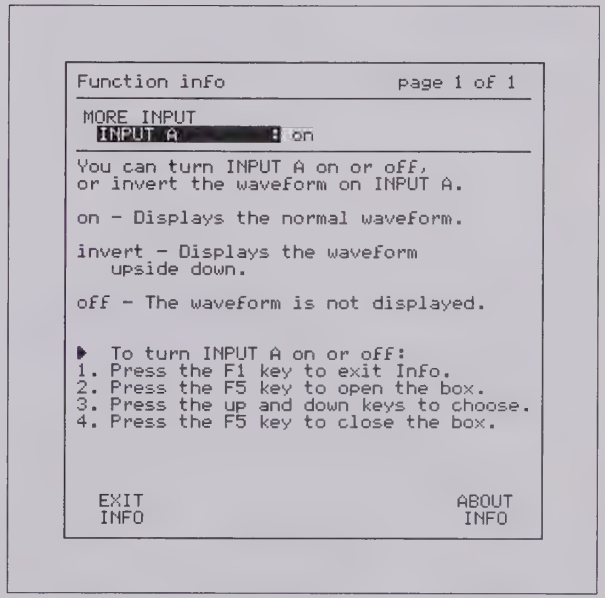

Function info page 1 of 1
MORE INPUT
INPUT A : on
You can turn INPUT A on or off,
or invert the waveform on INPUT A.
on - Displays the normal waveform.
invert - Displays the waveform
upside down.
off - The waveform is not displayed.
To turn INPUT A on or off:
1. Press the F1 key to exit Info.
2. Press the F5 key to open the box.
3. Press the up and down keys to choose.
4. Press the F5 key to close the box.
EXIT
INFO
ABOUT
INFO

*Figure 1-8 Using On-Line Information*

- When you have read the displayed information, press [F1] to exit the information mode.

This returns the test tool to the latest setup before you pressed [ⓘ], and you can continue your measurement.

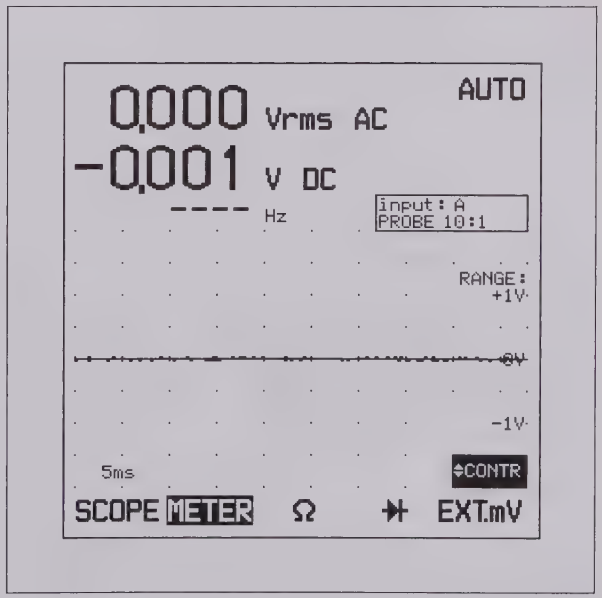
# Chapter 2
# Getting Started


**ADJUSTING THE DISPLAY** . . . . . 2-3
Adjusting the Contrast . . . . . 2-3
Turning the Backlight On and Off . . . . . 2-3
**SELECTING THE PROBE TYPE** . . . . . 2-4
**POWER-ON CONFIGURATIONS** . . . . . 2-4
Master Reset (Default Startup) . . . . . 2-4
Power-on/save memory . . . . . 2-5
**PERFORMING AN EASY SETUP** . . . . . 2-5
**USING THE DEMONSTRATION (DEMO) BOARD** . . 2-6
Quick Measurement Demonstration. . . . . 2-7
Performing Some Meter Operations. . . . . 2-10
Performing Some Scope Operations . . . . . 2-12

This chapter provides a 15-minute demonstration intended for those who are not familiar with the ScopeMeter test tool. It gives some hands-on experience, with an emphasis on learning by seeing and doing. Those who are familiar with the test tool can skip the following pages and continue to Chapter 3.

- Press [ON/OFF] to turn on the test tool.

Operation begins in the last-known configuration. Factory default settings are used at the first power-on. Subsequent power-ons maintain configuration changes made with keystrokes or through recall of a setup memory during the previous session.



## ADJUSTING THE DISPLAY

### Adjusting the Contrast

- Use △ ▽ to adjust the contrast of the display to your preference. Note that new contrast adjustment of the display is stored in memory until a new adjustment is made.

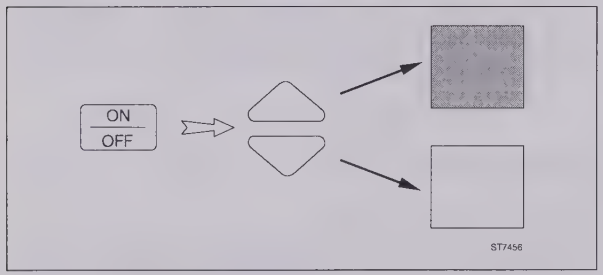



*Figure 2-1 Contrast adjustment*

Contrast adjustment can also be made after you have pressed [▲▼], and you have highlighted the contrast with △ ▽, and pressed [F5] to select. ▲▼CONTR is then visible in the right bottom of the display.

### Turning the Backlight On and Off

1. Press ☼ to turn on the backlight. The actual power source, BATTERIES or POWER ADAPTER appears for a moment on the display.

*NOTE*

*Using the backlight shortens battery power operation time by about $^1/_2$ hour.*

2. Press ☼ to turn off the backlight again.

## SELECTING THE PROBE TYPE

To prevent measurement errors, ensure that your test tool is adapted to your probe at power-on. Note that the PM8918 probes, delivered with the test tool, have an attenuation of 10:1.

For accurate measurement, periodic probe calibrations are necessary. This is explained in Chapter 9, "User Maintenance".

## POWER-ON CONFIGURATIONS

There are two different ways to reset the ScopeMeter test tool: the Master Reset, and the power-on/save memory.

**Master Reset (Default Startup)**

### CAUTION

**A Master Reset clears everything saved in memory. Never perform a Master Reset unless you are prepared to lose everything you saved in memory.**

1. Turn the ScopeMeter test tool off.
2. Press and hold F5.
3. Press and release ON/OFF.
   The test tool turns on, and you should hear a double beep, indicating the Master Reset was successful. The screen should display **input: A PROBE 10:1** on top of the waveform area.
4. Release F5.

Perform a Master Reset only to make sure that your test tool is in the initial settings condition. Master Reset sets the test tool for using 10:1 probes.

See Chapter 6 for more information about Master Reset conditions.

**Power-on/save memory**

This procedure also resets the ScopeMeter test tool and sets the probe range to 10:1. The Reset does not clear the memories.

1. Turn the test tool off.
2. Press and hold F4.
3. Press and release ON/OFF.
   The test tool turns on, and you should hear a double beep. **input: A PROBE 10:1** appears on the display.
4. Release F4.

Use this feature when you have saved a setup, screen, or waveform in memory.

## PERFORMING AN EASY SETUP

For quick operation, the test tool is equipped with a Continuous Auto Set function. This function optimizes the range and the time in all modes and assures a stable picture on nearly all waveforms. You only need to press AUTO SET to activate. Once activated this function permits hands-off probing.

You can redefine the Continuous Auto Set configuration to your own preference. Refer to Chapter 6 for more information.

## USING THE DEMONSTRATION (DEMO) BOARD

During the Quick Measurements, Quick Meter Operations, and Quick Scope Operations, you use the Demo Board that is included in your ScopeMeter test tool kit. Before doing any measurement, review the safety precautions in the beginning of this manual. Refer to Figure 2-2 for the setup of this demonstration.

- Connect the red scope probe to TP2.

Continue with the Quick Measurements Demonstration for more hands-on training using active waveforms.

*NOTE*

*The displays and measurements are typical. They will vary depending on the condition of the Demo Board battery.*

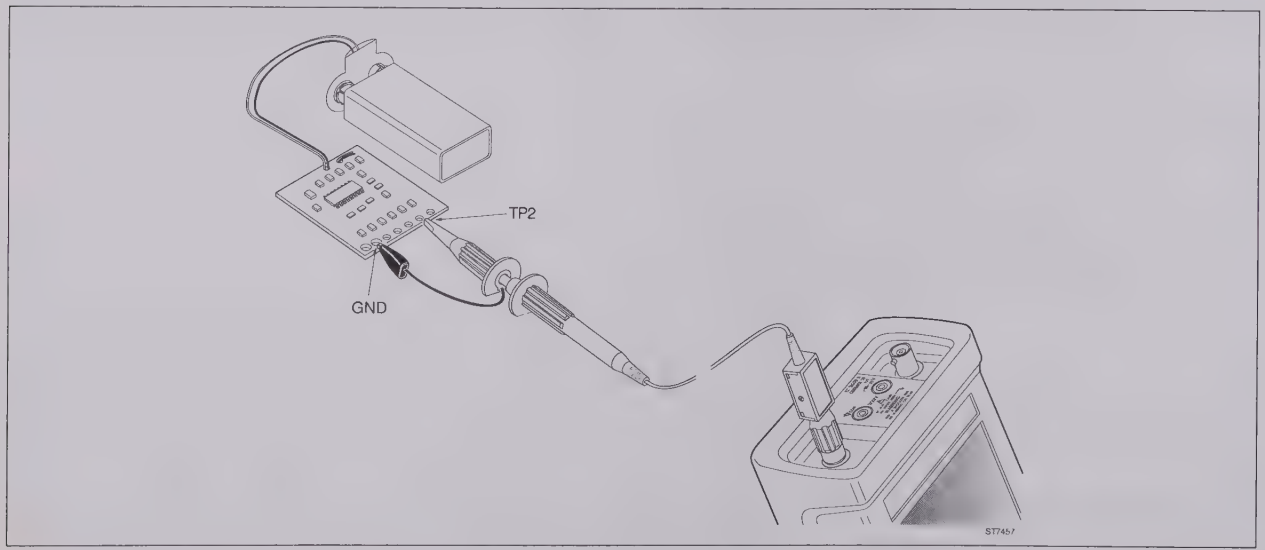


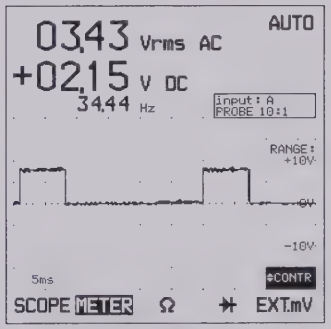

*Figure 2-2 Demonstration setup*

1. F4 + ON/OFF

Perform a Reset at Power ON.
At power-on, all five function key definitions in the bottom display are assigned to the Main menu. Notice that METER is highlighted.

Ensure the probe range is 10:1, as indicated on the display.

The screen displays about "03.43 Vrms AC" and "+02.15 V DC" in large numbers, and 34.44 Hz in smaller numbers. (The values can vary depending on the condition of the Demo Board battery.) An additional scope trace gives a graphical representation of the waveform.

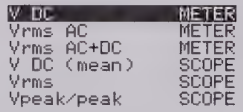



2. MEASURE MENU

Open the Measure menu; the five function keys now are assigned to: MORE MEASURE, V, Hz, dB, or TIME.

Continued on next page

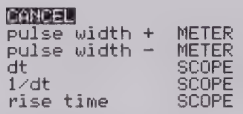
3. F2 — Open the VOLT measurement menu; a list of the voltage measurements appears on the display




4. △ + ▽ — Use these keys to choose a measurement. For now, highlight **Vrms AC+DC**.

5. F5 — Press this function key to select Vrms AC+DC. The value of about "4.00 Vrms AC+DC" appears as the main top reading on the display. The previous readings are now shifted down one. Note that the Hz has been removed.

6. F5 — Open the TIME measurement menu; a list of the time-related measurements appears on the display.

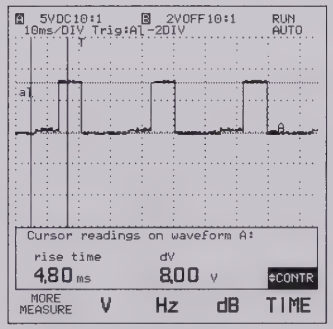



7. △ + ▽ — Choose another measurement. For now, highlight **rise time**. ~~91~~ ~~92~~

Continued on next page

8. F5 Some measurements are done in another mode. This message appears in a double-lined box on the display: "This measurement is possible in SCOPE mode. Change to SCOPE mode now ?".

9. F1 The test tool changes automatically to the Scope mode. You can now find the Rise Time measurement result below the waveform area.

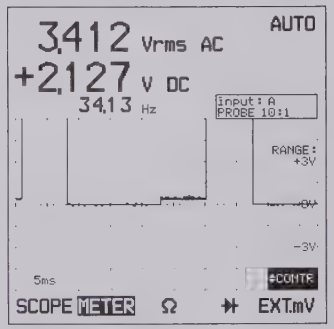



This completes the Quick Measurements Demonstration; continue with the Meter Operations.

If you have not already done so, perform a [F4] + [ON/OFF] reset.

1. [RANGE/V] Input A

   Set the Display to 3V manual range, about "3.580 Vrms AC" and "+2.232 V DC" appear, and the amplitude of the graphical representation increases.




2. [HOLD/RUN]

   Press this key once to measure a stable display. **TOUCH HOLD** appears in the top right of the display.

3. [HOLD/RUN]

   Press this key once again to resume new measurements.

4. [mV/RANGE] Input A

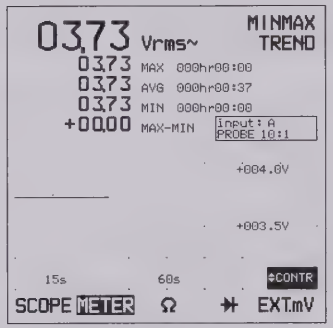
   Press this key. The display changes to 1V range. The voltage readings are overloaded, and "OL Vrms AC" and "+OL V DC" appear.

5. [AUTO SET]

   The test tool automatically assumes a new setup that is optimized for measuring the actual input signal.

Continued on next page

6. MIN MAX — Press this key once to start recording the maximum, average, minimum, and max-min measurements. At the same time the trend plot representation appears at the lower area of the display.




7. MIN MAX — Press this key again to stop Min Max recording and trend plot.

8. SUB MENU — Open the Meter-submenu mode. The five function keys are now assigned to the meter-submenu identifiers.

9. F1 — Open the More Meter window. The window enables you to change several settings in Meter mode.

10. F4 — Go to the next page and find more settings that you can change.

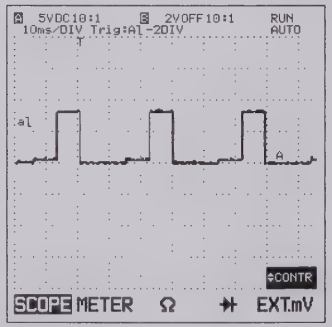
11. F2 — Close the window again, without changing the setup configuration of the test tool.

This completes the Meter Operations demo; continue with the Scope Operations.

*PERFORMING SOME METER OPERATIONS*

If you have not already done so perform a [F4] + [ON/OFF] reset.

1. [F1] / [AUTO SET] — Activate the Scope Mode, then press [AUTO SET]. An image of the waveform appears on the display. The top display shows the attenuator, probe, time base, and trigger information.




2. [RANGE/V] A — The waveform amplitude decreases. The attenuator scale in the top display changes to a less sensitive range.

3. [s TIME] — The number of periods of the waveform increases. The time base scale in the top display changes to a slower time/DIV.

4. [MOVE △] A — The waveform shifts upwards.

5. [MOVE ▷] — The waveform shifts to the right of the display.

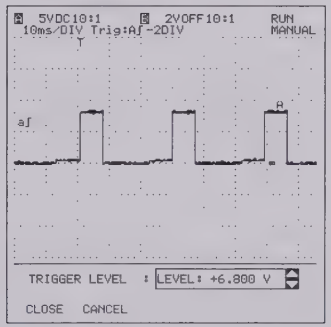
Continued on next page

6. AUTO SET — The test tool automatically selects attenuation, time base, and triggering to give you a readable display of the waveform.

7. TRIGGER — Press this to look at the Trigger menu now.

8. F2 — This begins to display as the waveform rises above the trigger level (+SLOPE) or falls below the trigger level (-SLOPE). Watch the display; the waveform starts at a different place as trigger + or - is selected. Continue with +SLOPE selected.

9. F4 — This activates the ADJUST LEVEL function. The level value is displayed in the right bottom, and is visualized by the "**a**⌠" icon on the left edge of the display. Ensure also that **RUN** is displayed in the top right of the display as an indication that your test tool is triggered.




Continued on next page

10. Adjust the trigger level: the "**a**⌠" icon moves upward as you change the trigger level. When the level is more than the waveform value, **RUN** changes into **NOTRIG**, and the display becomes unstable; your test tool is no longer triggered.

11. Adjust the trigger level to about 50% of the waveform amplitude, so that your test tool is triggered again.

12.

Turn your ScopeMeter test tool off.

You are now able to operate basic functions in routine applications. Continue with Chapters 3 and 4 for a more detailed discussion of the ScopeMeter test tool functions.

# Chapter 3
# Making Measurements


MAKING CONNECTIONS . . . . . 3-2
USING MEASUREMENT FUNCTIONS . . . . . 3-3
ORDERING MEASUREMENT READINGS . . . . . 3-4
MEASURING VOLTAGE FUNCTIONS (V) . . . . . 3-5
MEASURING FREQUENCY FUNCTIONS (Hz) . . . . . 3-6
MEASURING POWER AS dB . . . . . 3-7
MEASURING TIME FUNCTIONS . . . . . 3-8
MEASURING THE ADDITIONAL FUNCTIONS . . . . . 3-9
MEASURING FUNCTIONS NOT AVAILABLE FROM THE MEASURE MENU . . . . . 3-11
Additional measurements for Meter and EXT.mV 3-11
Additional measurements for the Scope . . . . . 3-12
USING THE MEASUREMENTS MAP . . . . . 3-13

## MAKING CONNECTIONS

ScopeMeter test tool measurement connections are illustrated in Figure 3-1.

Use the red INPUT A BNC jack or the red and black 4-mm banana jacks for measurements. The ScopeMeter test tool informs you when to use INPUT A or the banana jacks.

The red 4-mm banana jack is used for diode test, continuity test, Ohm measurement, and when you use a Current or Temperature probe with banana plugs.

When you use the PM8918 probe, select the 10:1 probe type for correct decimal readout.

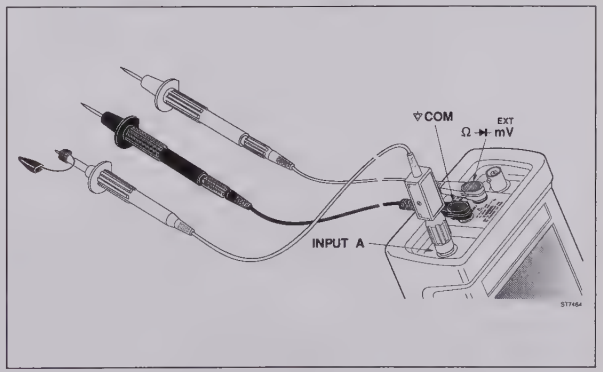



*Figure 3-1 Measurement Connections*

## USING MEASUREMENT FUNCTIONS

Use the Measure menu to choose one or more automatic measurements. Simply choose your desired measurement and the test tool sets itself up and displays the result.

- Regardless of the mode you are in, press [MEASURE MENU] to access the Measure menu.

MORE MEASURE V Hz dB TIME

*Measure Menu*

Use one of the function keys [F2], [F3], [F4], or [F5] to choose the type of measurement: V, Hz, dB, or TIME. This opens a window with a list of the most commonly used measurements within the chosen type. [F1] (MORE MEASURE) gives access to a multipage list of all possible measurements, see below.

When you have opened a window, use △ and ▽ to highlight the desired measurement, then press [F5] to select. Finally, press [F1] (CLOSE) to activate your chosen measurement and to close the window. The measurement result is instantly displayed on the screen.

See Figure 3-2 for screen examples in Dual Display mode and Scope mode.

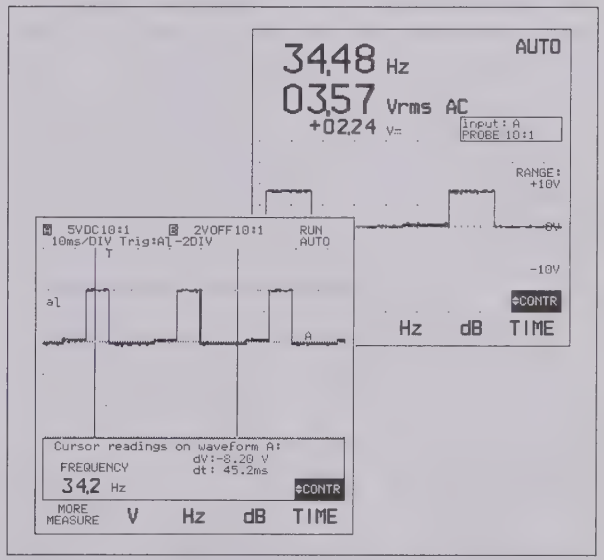



*Figure 3-2 Measurement Results in Dual Display Mode and Scope Mode*

*NOTE*

*The Scope Mode measurements are not valid for the FLUKE 91 and 92.*

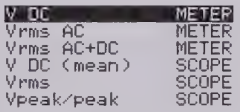
## ORDERING MEASUREMENT READINGS

At default, three measurement readings are displayed at the same time, although you can display up to four readings. See Chapters 4 and 6 for more information.

When you exceed the number of selected readings, all readings shift down one and your latest chosen measurement is placed on top. Notice that the previous bottom reading is then removed.

## MEASURING VOLTAGE FUNCTIONS (V)

- Press F2 (V) to open a list with voltage measurements:




*Volt List Box*

*NOTE*

*INPUT A in Meter mode can make separate V DC and Vrms AC measurements on the same signal at the same time. V DC and Vrms AC readings are normally displayed together.*

**V DC METER** Measure the DC (direct) voltage of the input signal in Meter mode.

**Vrms AC METER** Measure the RMS (Root Mean Square) voltage of the input signal in Meter mode. This is done with DC-coupled input. Allows the AC component of signal to be displayed.

**Vrms AC+DC METER** Measure the true RMS (Root Mean Square) voltage of the input signal in Meter mode. If a DC-offset is present, this measurement will read higher or lower than Vrms AC. If there is no DC offset present, this measurement will be the same as Vrms AC.

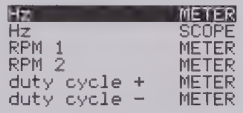
**V DC (mean) SCOPE** Measure the mean (average of readings) value of the waveform between the (vertical) cursors in Scope mode.

**Vrms SCOPE** Measure the RMS (Root Mean Square) voltage of the waveform between the (vertical) cursors in Scope mode.

**V peak/peak SCOPE** Measure the difference between the highest and lowest voltage value of the waveform between the (vertical) cursors in Scope mode.

## MEASURING FREQUENCY FUNCTIONS (Hz)

- Press [F3] (Hz) to open a list with frequency measurements:




*Frequency List Box*

**Hz METER** Measure the frequency of the input signal in Meter mode.

**Hz SCOPE** Measure the frequency of the waveform in Scope mode. At least $1^1/_2$ cycles of this waveform must occur between the cursors.

**RPM 1 METER** (revolutions per minute) Measure one count per revolution in Meter mode.

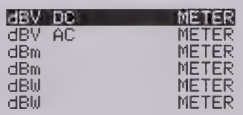
**RPM 2 METER** (revolutions per minute) Measure one count per two revolutions in Meter mode.

**duty cycle + METER** Measure the ratio between the time the signal is positive to the total period time in Meter mode. It is shown as a percentage figure.

**duty cycle - METER** Measure the ratio between the time the signal is negative to the total period time in Meter mode. It is shown as a percentage figure.

## MEASURING POWER AS dB

- Press [F4] (dB) to open a list with power measurements:




*dB List Box*

**dBV DC METER** (decibel Volts) Measure the voltage ratio of the DC component of a signal with respect to a reference voltage in Meter mode. This is done with DC-coupled input.

**dBV AC METER** (decibel Volts) Measure the voltage ratio of the AC component of a signal with respect to a reference voltage in Meter mode. This is done with DC-coupled input.

**dBm DC METER** (decibel milliwatt) Measure the power ratio of the DC component of a signal with respect to 1 mW in Meter mode. This is done with DC-coupled input.

**dBm AC METER** (decibel milliwatt) Measure the power ratio of the AC component of a signal with respect to 1 mW in Meter mode. This is done with DC-coupled input.

**dBW DC METER** (decibel Watt) Measure the power ratio of the DC component of a signal with respect to 1W in Meter mode. This is done with DC-coupled input.

**dBW AC METER** (decibel Watt) Measure the power ratio of the AC component of a signal with respect to 1W in Meter mode. This is done with DC-coupled input.

For **dBV**, **dBm,** and **dBW**, you can select a range of references by pressing △ or ▽.

**dBV**: Choose a voltage between 50 mV and 9.99V. The default value is 1V.

**dBm**: Choose one of the following reference impedances: 50, 60, 75, 93, 110, 125, 135, 150, 250, 300, 500, 600, 800, 900, 1000, or 1200Ω.

**dBW**: Choose one of the following references: 1, 2, 4, 8, 16, or 50Ω

## MEASURING TIME FUNCTIONS

- Press F5 (TIME) to open a list with time measurements:

```
CANCEL
pulse width +   METER
pulse width -   METER
dt              SCOPE
1/dt            SCOPE
rise time       SCOPE
```

*TIME List Box*

**CANCEL** Ignore TIME window selection and return to the Measure menu again.

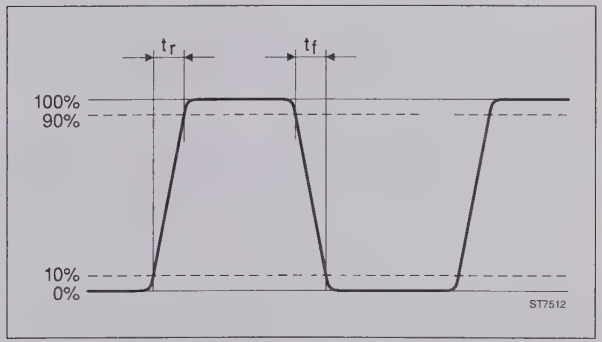
**pulse width + METER** Measure the duration of the first positive-going pulse of the waveform in Meter mode.

**pulse width - METER** Measure the duration of the first negative-going pulse of the waveform in Meter mode.

**dt (delta time) SCOPE** Measure the time difference between the (vertical) cursors in Scope mode.

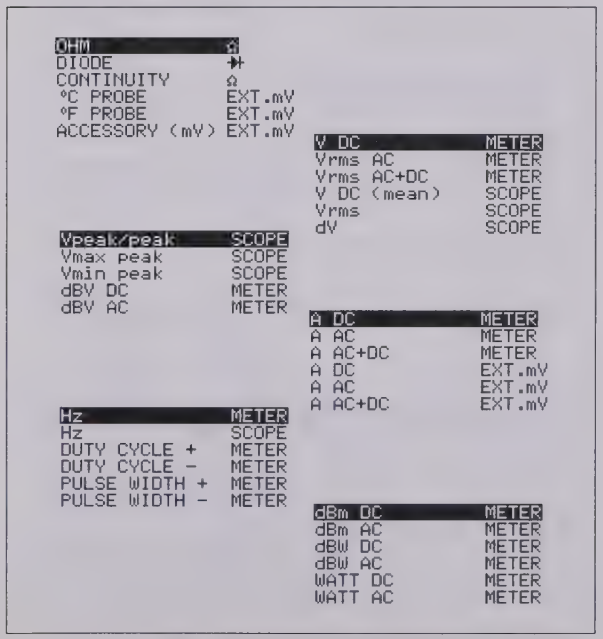
**1/dt (frequency) SCOPE** Measure the relative frequency of the waveform in Scope mode. This is shown as the reciprocal value of the time difference (dt) between the vertical cursors.

**rise time SCOPE** Measure the rise time between 10% and 90% points of the first rising slope of the waveform in Scope mode. The 0% and 100% points are determined by the intersection of the waveform cursors. Set the rising slope to at least four time divisions for a precise measurement.



## MEASURING THE ADDITIONAL FUNCTIONS

Press [F1] (MORE MEASURE) to access a six-page list of all possible measurements, including those found with the [F2] through [F5] function keys. Press [F3] (PREVIOUS PAGE) and [F4] (NEXT PAGE) to step through the pages in the More Measure window.




Additional measurements in the More Measure window are listed below.

**Page 1:**

**OHM** Ω Measure the resistor value (Ω) of a resistor connected to the red and black 4-mm banana jacks.

**DIODE** ⏚ Test a diode that is connected to the red and black 4-mm banana jacks. The red banana jack is the high input, and the black one is the low. The result is displayed as the forward or reverse voltage of a diode.

**CONTINUITY** Ω Detect an open or closed circuit that is connected to the red and black 4-mm banana jacks. A beeper draws your attention when the circuit is closed.

**°C PROBE EXT.mV** Detect a temperature in degrees Celsius with a Temperature probe (optional) that is connected to the red and black 4-mm banana jacks.

**°F PROBE EXT.mV** Detect a temperature in degrees Fahrenheit with a Temperature probe (optional) that is connected to the red and black 4-mm banana jacks.

**ACCESSORY (mV) EXT.mV** Measure millivolts with an accessory that is connected to the red and black 4-mm banana jacks.

**Page 2:**

**dV SCOPE** Measure the voltage difference between the (horizontal) cursors in Scope mode.

The other measurements can be found from F2 (V).

**Page 3:**
**V max peak SCOPE** Measure the maximum peak value of the waveform between the cursors in Scope mode.

**V min peak SCOPE** Measure the minimum peak value of the waveform between the cursors in Scope mode.

The other measurements can be found from F2 (V) or F4 (dB).

**Page 4:**
**A DC METER** Displays the voltage output from a Current probe (available as an option) that is connected to the INPUT A BNC as DC current. This is done with DC-coupled input. A list box enables you to select the proper range: 1, 10, 100 mV/A, or 1 V/A.

**A AC METER** Measure the AC current in Meter mode with a Current probe (available as an option) that is connected to the INPUT A BNC. This is done with DC-coupled input. A list box enables you to select the proper range: 1, 10, 100 mV/A, or 1 V/A.

**A AC+DC METER** Measure the AC+DC current in Meter mode with a Current probe (available as an option) that is connected to the INPUT A BNC. This is done with DC-coupled input. A list box enables you to select the proper range: 1, 10, 100 mV/A, or 1 V/A.

**A DC EXT.mV** Measure the DC current in EXT.mV mode with a Current probe (available as an option) that is connected to the red and black 4-mm banana jacks. This is done with DC-coupled input. A list box enables you to select the proper range: 1, 10, 100 mV/A, or 1 V/A.

**A AC EXT.mV** Measure the AC current in EXT.mV mode with a Current probe (available as an option) that is connected to the red and black 4-mm banana jacks. This is done with DC-coupled input. A list box enables you to select the proper range: 1, 10, 100 mV/A, or 1 V/A.

**A AC+DC EXT.mV** Measure the AC+DC current in EXT.mV mode with a Current probe (available as an option) that is connected to the red and black 4-mm banana jacks. This is done with DC-coupled input. A list box enables you to select the proper range: 1, 10, 100 mV/A, or 1 V/A.

**Page 5:**
All measurements can be found from F3 (Hz) or F5 (TIME).

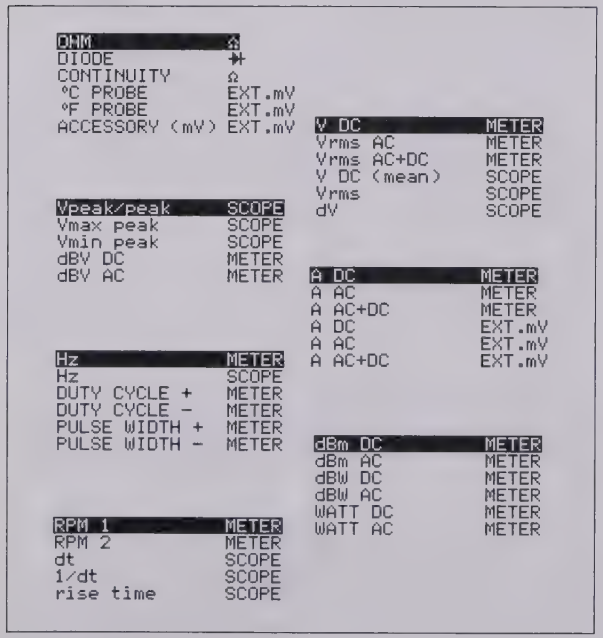
**Page 6:**
**WATT DC METER** Measure the DC audio watts from the signal in Meter mode. This is done with DC-coupled input. You can choose 1, 2, 4, 8, 16, or 50Ω as reference impedance.

**WATT AC METER** Measure the AC audio watts from the signal in Meter mode. This is done with DC-coupled input. You can choose 1, 2, 4, 8, 16, or 50Ω as reference impedance.

The other measurements can be found from F4 (dB).

## MEASURING THE ADDITIONAL FUNCTIONS

Press [F1] (MORE MEASURE) to access a seven-page list of all possible measurements, including those found with the [F2] through [F5] function keys. Press [F3] (PREVIOUS PAGE) and [F4] (NEXT PAGE) to step through the pages in the More Measure window.




Additional measurements in the More Measure window are listed below.

**Page 1:**

**OHM** Ω Measure the resistor value (Ω) of a resistor connected to the red and black 4-mm banana jacks.

**DIODE** Test a diode that is connected to the red and black 4-mm banana jacks. The red banana jack is the high input, and the black one is the low. The result is displayed as the forward or reverse voltage of a diode.

**CONTINUITY** Ω Detect an open or closed circuit that is connected to the red and black 4-mm banana jacks. A beeper draws your attention when the circuit is closed.

**°C PROBE EXT.mV** Measure a temperature in degrees Celsius with a Temperature probe (optional) that is connected to the red and black 4-mm banana jacks.

**°F PROBE EXT.mV** Measure a temperature in degrees Fahrenheit with a Temperature probe (optional) that is connected to the red and black 4-mm banana jacks.

**ACCESSORY (mV) EXT.mV** Measure millivolts with an accessory that is connected to the red and black 4-mm banana jacks.

**Page 2:**

**dV SCOPE** Measure the voltage difference between the (horizontal) cursors in Scope mode.

The other measurements can be found from [F2] (V).

**Page 3:**
**V max peak SCOPE** Measure the maximum peak value of the waveform between the cursors in Scope mode.

**V min peak SCOPE** Measure the minimum peak value of the waveform between the cursors in Scope mode.

The other measurements can be found from [F2] (V) or [F4] (dB).

**Page 4:**
**A DC METER** Displays the voltage output from a Current probe (available as an option) that is connected to the INPUT A BNC as DC current. This is done with DC-coupled input. A list box enables you to select the proper range: 1, 10, 100 mV/A, or 1 V/A.

**A AC METER** Measure the AC current in Meter mode with a Current probe (available as an option) that is connected to the INPUT A BNC. This is done with DC-coupled input. A list box enables you to select the proper range: 1, 10, 100 mV/A, or 1 V/A.

**A AC+DC METER** Measure the AC+DC current in Meter mode with a Current probe (available as an option) that is connected to the INPUT A BNC. This is done with DC-coupled input. A list box enables you to select the proper range: 1, 10, 100 mV/A, or 1 V/A.

**A DC EXT.mV** Measure the DC current in EXT.mV mode with a Current probe (available as an option) that is connected to the red and black 4-mm banana jacks. This is done with DC-coupled input. A list box enables you to select the proper range: 1, 10, 100 mV/A, or 1 V/A.

**A AC EXT.mV** Measure the AC current in EXT.mV mode with a Current probe (available as an option) that is connected to the red and black 4-mm banana jacks. This is done with DC-coupled input. A list box enables you to select the proper range: 1, 10, 100 mV/A, or 1 V/A.

**A AC+DC EXT.mV** Measure the AC+DC current in EXT.mV mode with a Current probe (available as an option) that is connected to the red and black 4-mm banana jacks. This is done with DC-coupled input. A list box enables you to select the proper range: 1, 10, 100 mV/A, or 1 V/A.

**Page 5 and Page 7:**
All measurements can be found from [F3] (Hz) or [F5] (TIME).

**Page 6:**
**WATT DC METER** Measure the DC audio watts from the signal in Meter mode. This is done with DC-coupled input. You can choose 1, 2, 4, 8, 16, or 50Ω as reference impedance.

**WATT AC METER** Measure the AC audio watts from the signal in Meter mode. This is done with DC-coupled input. You can choose 1, 2, 4, 8, 16, or 50Ω as reference impedance.

The other measurements can be found from [F4] (dB).

## MEASURING FUNCTIONS NOT AVAILABLE FROM THE MEASURE MENU

There are also a few more measurements that you can only find in the Scope, Meter or EXT.mV modes. These are listed below.

Chapter 4 describes how to select the Meter and EXT.mV mode measurements, and Chapter 5 the Scope mode measurements.

**Additional measurements for Meter and EXT.mV**

**Vrms AC (no DC)** Measure the RMS (Root Mean Square) voltage of the input signal in Meter mode. This is done with AC-coupled input so that the DC signal component is blocked and the range is optimized for the AC signal component. The V DC reading is inhibited due to AC coupling. In some cases this measurement gives one more digit of resolution over Vrms AC (DC coupled).

**dBV AC+DC** (decibel Volts) Measure the voltage ratio of the AC and DC components of a signal with respect to a reference voltage in Meter mode. This is done with DC-coupled input.

**dBV AC (no DC)** (decibel Volts) Measure the voltage ratio of the AC component of a signal with respect to a reference voltage in Meter mode. This is done with AC-coupled input so that the DC signal component is blocked and the range is optimized for the AC signal component.

**dBm AC** (decibel milliwatt) Measure the power ratio of the AC component of a signal with respect to 1 mW in Meter mode. This is done with DC-coupled input.

**dBm AC (no DC)** (decibel milliwatt) Measure the power ratio of the AC and DC components of a signal with respect to 1 mW in Meter mode. This is done with AC-coupled input so that the DC signal component is blocked and the range is optimized for the AC signal component.

**dBW AC+DC** (decibel Watt) Measure the power ratio of the AC and DC components of a signal with respect to 1W in Meter mode. This is done with DC-coupled input.

**dBW AC (no DC)** (decibel Watt) Measure the power ratio of the AC component of a signal with respect to 1W in Meter mode. This is done with AC-coupled input so that the DC signal component is blocked and the range is optimized for the AC signal component.

**WATT AC+DC** Measure the AC and DC audio watts from the signal in Meter mode. This is done with DC-coupled input. You can choose 1, 2, 4, 8, 16, or 50Ω as reference impedance.

**WATT AC (no DC)** Measure the AC audio watts from the signal in Meter mode. This is done with AC-coupled input so that the DC signal component is blocked and the range is optimized for the AC signal component. You can choose 1, 2, 4, 8, 16, or 50Ω as reference impedance.

For **dBV**, **dBm** and **dBW**, you can select a range of references by pressing or .

**dBV**: Choose a voltage between 50 mV and 9.99V. The default value is 1V.

**dBm**: Choose one of the following reference impedances: 50, 60, 75, 93, 110, 125, 135, 150, 250, 300, 500, 600, 800, 900, 1000, or 1200Ω.

**dBW**: Choose one of the following references: 1, 2, 4, 8, 16, or 50Ω.

**Additional measurements for the Scope**

**dV** (for delta Volts) Measure the voltage difference between the (horizontal) cursors.

**dt** (for delta time) Measure the time difference between the (vertical) cursors.

**1/dt** (for relative frequency) Show the reciprocal value of dt.

**TRIG to left** Measure the time difference between the trigger occurrence and the left cursor.

**TRIG to right** Measure the time difference between the trigger occurrence and the right cursor.

**V at left** Measure the voltage amplitude where the left cursor crosses the waveform.

**V at right** Measure the voltage amplitude where the right cursor crosses the waveform.

**phase** Measure the phase shift between two waveforms. A maximum of three phase-shift measurements are possible.

## USING THE MEASUREMENTS MAP

The measurements can be selected in various menus. The following Measurements map shows where you can find all measurements.

| | MEASURE MENU | MAIN MENU | | | | |
|---|---|---|---|---|---|---|
| | | SCOPE | METER | Ω | ⊣⊢ | EXT.mV |
| ***Voltage Measurements*** | | | | | | |
| V DC | ● | | ● | | | ● |
| Vrms AC | ● | | ● | | | ● |
| Vrms AC+DC | ● | | ● | | | ● |
| Vrms AC (No DC) | | | ● | | | |
| V DC (mean) | ● | ● | | | | |
| Vrms | ● | ● | | | | |
| dV | ● | ● | | | | |
| Vpeak/peak | ● | ● | | | | |
| V max peak | ● | ● | | | | |
| V min peak | ● | ● | | | | |
| V at left | | ● | | | | |
| V at right | | ● | | | | |
| ACCESSORY (mV) | ● | | | | | ● |
| ***Frequency Measurements*** | | | | | | |
| Hz (frequency) | ● | ● | ● | | | ● |
| DUTY CYCLE | ● | | ● | | | ● |
| RPM 1 | ● | | ● | | | ● |
| RPM 2 | ● | | ● | | | ● |

| | MEASURE MENU | MAIN MENU | | | | |
|---|---|---|---|---|---|---|
| | | SCOPE | METER | Ω | ⊣⊢ | EXT.mV |
| ***Power Measurements*** | | | | | | |
| dBV DC | ● | | ● | | | ● |
| dBV AC | ● | | ● | | | ● |
| dBV AC+DC | | | ● | | | ● |
| dBV AC (no DC) | | | ● | | | |
| dBm DC | ● | | ● | | | ● |
| dBm AC | ● | | ● | | | ● |
| dBm AC+DC | | | ● | | | ● |
| dBm AC (no DC) | | | ● | | | |
| dBW DC | ● | | ● | | | ● |
| dBW AC | ● | | ● | | | ● |
| dBW AC+DC | | | ● | | | ● |
| dBW AC (no DC) | | | ● | | | |
| WATT DC | ● | | ● | | | ● |
| WATT AC | ● | | ● | | | ● |
| WATT AC+DC | | | ● | | | ● |
| WATT AC (no DC) | | | ● | | | |
| ***Time Measurements*** | | | | | | |
| PULSE WIDTH | ● | | ● | | | ● |
| dt | ● | ● | | | | |
| 1/dt | ● | ● | | | | |
| RISE TIME | ● | ● | | | | |
| TRIG to left | | ● | | | | |
| TRIG to right | | ● | | | | |
| PHASE | | ● | | | | |

| | MEASURE MENU | MAIN MENU | | | | |
|---|---|---|---|---|---|---|
| | | SCOPE | METER | Ω | ⊣⊢ | EXT.mV |
| ***Ampere Measurements*** | | | | | | |
| A DC | ● | | ● | | | ● |
| A AC | ● | | ● | | | ● |
| A AC+DC | ● | | ● | | | ● |
| A AC (no DC) | | | ● | | | |
| ***Temperature Measurements*** | | | | | | |
| °C | ● | | | | | |
| °F | ● | | | | | |
| ***Resistance Measurements*** | | | | | | |
| Ohm | ● | | | ● | | |
| Continuity | ● | | | ● | | |
| ***Diode Measurements*** | | | | | | |
| Diode | ● | | | | ● | |

# Chapter 4
# Using the Dual Display Mode Functions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## MAKING CONNECTIONS

ScopeMeter test tool measurement connections are illustrated in Figure 4-1.

Use the red INPUT A BNC jack for Scope and Meter modes. Use the grey INPUT B BNC jack as a second input for Scope measurements ~~91~~. The red and black 4-mm banana jacks are used for Ω, ⊣⊢, and EXT.mV modes.

For low frequency measurements (up to about 2 MHz), ground can be connected to the black 4-mm banana jack. For higher frequencies you must use the HF Adapter or Mini Testhook on the probe.

When you use the PM8918 probe, select the 10:1 probe type for correct decimal readout.

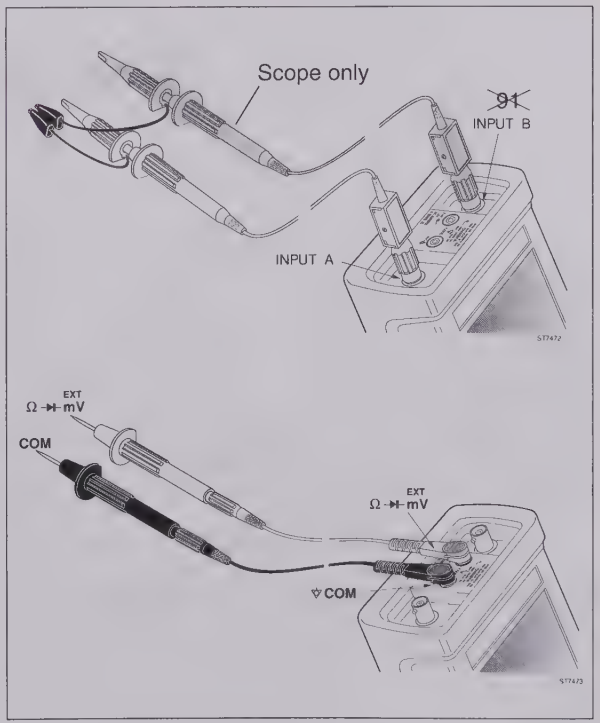



*Figure 4-1 Measurement Connections*

## SELECTING A MAIN MODE

At power-on, the main menu at the bottom of the display is always shown. The get the main menu from another menu or screen, press [SCOPE METER].

SCOPE METER Ω ⊣⊢ EXT.mV

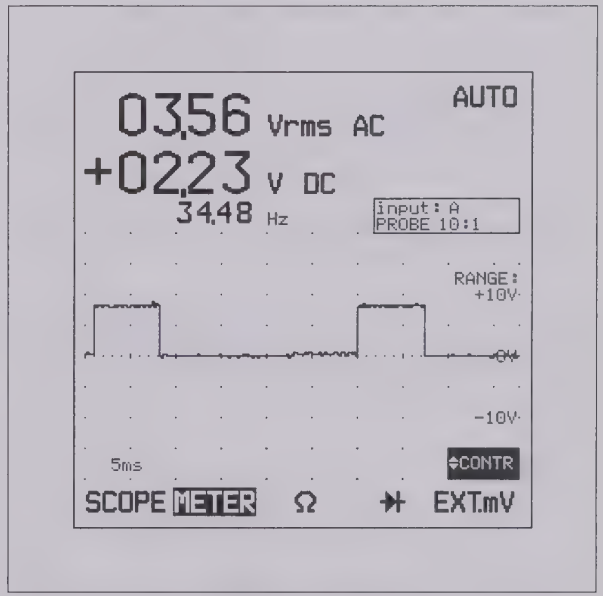
*Main menu*

Choose a main mode with any of the function keys: SCOPE, METER, Ω, ⊣⊢, or EXT.mV.

The measuring result is then displayed.

[F1] **SCOPE** INPUT A and INPUT B are used to measure the signal waveforms. You can set the amplitude of both waveforms, time base speed, and triggering for an optimum trace display. See Chapter 5 for more information about SCOPE mode.

[F2] **METER** Signals supplied to INPUT A are measured. Two measurement results appear initially on the display in a 3 2/3-digit numeric display. At the same time you find the graphic representation of the waveform in the lower display.



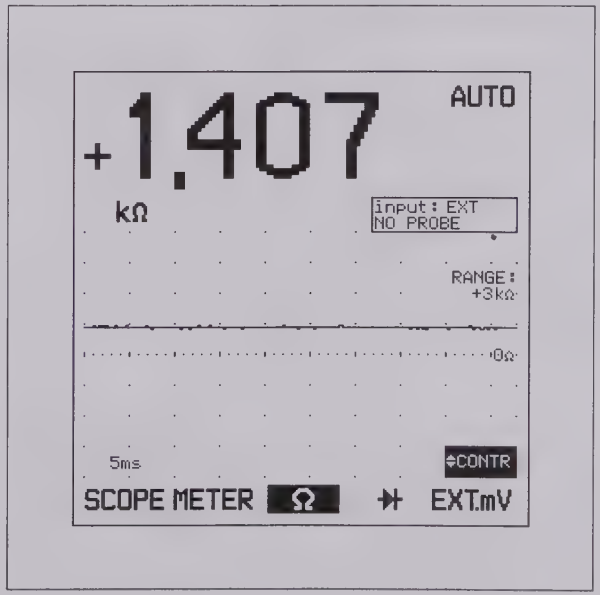

You can select the type and number of readings in the MORE METER window; press [SUB MENU] and [F1] to open the window.

If necessary, you can select the range of both the scope trace and meter display, and the time base speed.

- Press [mV RANGE] [RANGE V] to select the desired attenuation. Ranges are from 1V to 3 kV/div (Vrms: 2.5 kV/div) with 10:1 probe, or from 100 mV to 300 V/div (Vrms: 250 V/div) with direct 1:1 input.

- Press [s TIME ns] to select the desired time base; ranges are from 1 µs to 100 ms/div.

[F3] Ω Resistance mode. A resistor connected to the red and black 4-mm banana jack inputs is measured. The red banana jack is the high input, and the black banana jack (COM) is the low. The time base is fixed at 5 ms/DIV.




*NOTE*

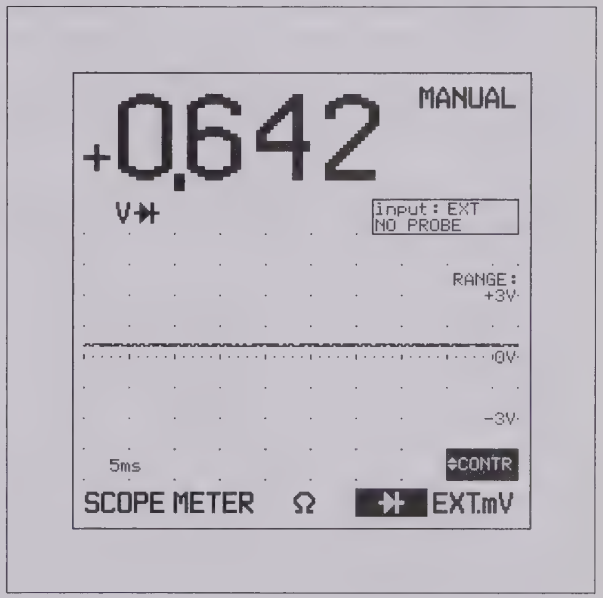
*In the diode and resistance modes, the black COMmon banana jack is not connected internally to the common of BNC INPUTS A and B.*

The measurement result is displayed as a 3 2/3-digit display. The ranges are 30Ω (manual only), 300Ω, 3 kΩ, 30 kΩ, 300 kΩ, 3 MΩ, and 30 MΩ. A beeper alert is generated at <5% of a selected range in Manual Range mode. The beeper alert is turned on with ALERT ))).

F4 ⊣⊢ Diode test mode. A diode connected to the red and black 4-mm banana jack inputs is tested. The measurement current through the diode is 0.5 mA. The red banana jack is the high input, and the black banana jack (COM) is the low.

The result is displayed as the forward or reverse voltage of the diode. A beeper alert is generated at forward voltage. The beeper alert is turned on with ALERT ))).

The time base is fixed at 5 ms/DIV and the attenuator at 3V.

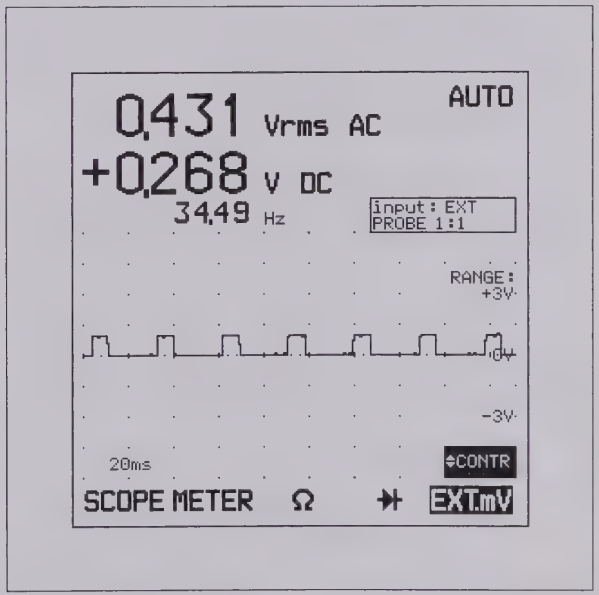



*NOTE*

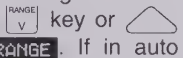
*In the diode and resistance modes, the black COMmon banana jack is not connected internally to the common of BNC INPUTS A and B.*

F5 **EXT.mV** EXTernal milliVolt function. Signals supplied to the red and black 4-mm banana jack inputs are measured. The red banana jack is the high input, and the black banana jack (COM) is the low. The ranges are 300 mV, and 3V. Time base ranges are from 1 µs to 100 ms/div.

Use this mode for low voltages and for the accessories available for the ScopeMeter test tool.



## SELECTING RANGES (MANUAL/AUTO RANGE)

In manual range, the input attenuator range can be changed by pressing the INPUT A [mV RANGE] [RANGE V] key or  , when these are assigned to ⇕RANGE. If in auto range, this switches automatically to manual range, and **MANUAL** appears in the top right of the display. The selected attenuator and time base ranges are shown on the display.

The desired time base range can be selected by pressing [s TIME ns].

Auto ranging (automatic setting of the attenuator and time base) is selected when you press [AUTO SET].

## HOLDING A STABLE MEASUREMENT (TOUCH HOLD®)

The Touch Hold function captures the next stable measurement and a beep indicates that a stable measurement has been made. When the Touch Hold function is turned on, the numeric display is frozen (held) until a stable measurement is detected. Stable measurements are defined as within +/-100 display counts for 1s; and above 200 display counts for dc signals, 300 display counts for ac signals, and below overload (OL) in Ω and diode test. **TOUCH HOLD** appears in the top right of the display when the function is active.

The following procedure can be used for Touch Hold:

1. Press [HOLD RUN] and measure the signal.
2. Wait until the ScopeMeter test tool produces a beeper signal to indicate a stable signal.
3. Remove the measuring leads and read the result from the display.
4. Measure a new signal, wait for the beeper, remove the leads, and read again.
5. Press [HOLD RUN] to return to normal measurement mode.

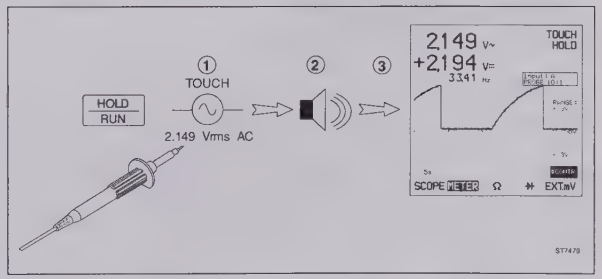



*Figure 4-2 The Touch Hold function*

*NOTE*

*The Touch Hold function is not available in Min Max.*

## DISPLAYING MINIMUM AND MAXIMUM READINGS WITH RELATED TRENDPLOT

### Displaying a Min Max Record

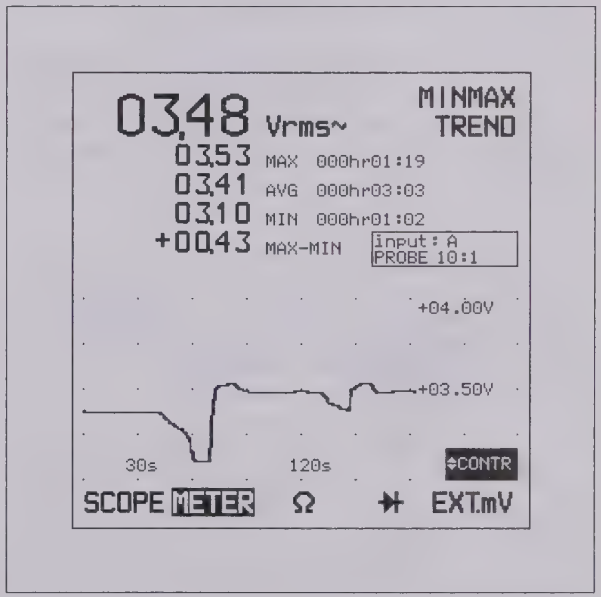
Press [MIN MAX] to record the maximum (**MAX**), average (**AVG**), minimum (**MIN**), and difference (**MAX-MIN**) readings of the main (upper displayed) measurement. The test tool also continues to display the present reading. Time stamps appear next to the MAX, AVG, and MIN readings to show the elapsed time in hours, minutes, and seconds since the Min Max start to the most recent change in the respective reading. The AVG time stamp updates continuously. The MAX and MIN time stamps update only when new high or low readings are encountered.

*NOTE*

*A beep occurs when a new MAX or MIN value is detected. New MIN, MAX, and AVG readings are then updated on the display.*

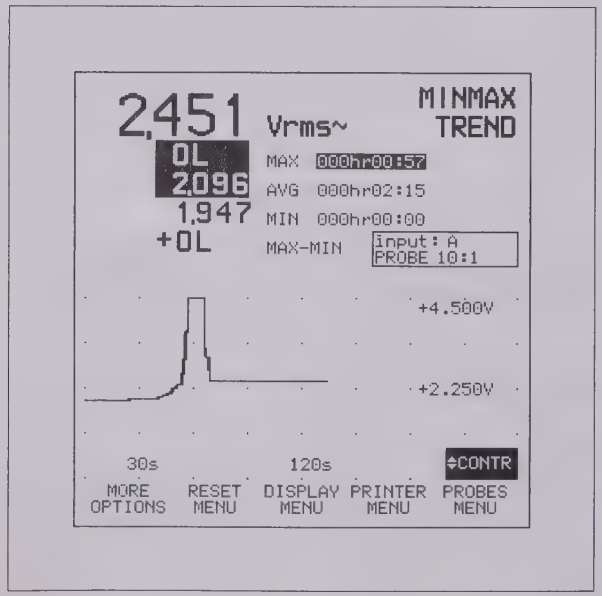
### Displaying the Min Max TrendPlot™

The test tool also continuously logs the maximum, average, and minimum readings to memory and displays all three as graphs. Vertical scaling and horizontal time compression are automatically resized to fit the TrendPlot on the display. The TrendPlot is slowly traced on the display from left to right until the screen is written and the time scale is resized. The initial time scale is 15s/DIV; after a full screen the scale is compressed to 30s, 1 min, 2 min, etc, to a maximum of 40 days over a whole display.



## ATTENTION

**An overload of MAX or MIN will stop the Min Max record mode. The overloaded value (MAX or MIN) and the AVG are then displayed in reverse video, and the time stamp of the overloaded value is stopped. The TrendPlot will continue.**




### Freezing the Display

You can press [HOLD RUN] at any time to freeze the displayed readings. **HOLD** appears in the top right of the display. Press [HOLD RUN] a second time to resume the display updates.

Turn Min Max off again with one of the following actions:

- Press [MIN MAX] a second time.
- Press [AUTO SET].
- Select a new measurement.

## SELECTING THE SCOPEMETER KEY SUBMENU

From any main mode, you can access the main mode submenu by pressing [SUB MENU] for more control over the selected mode. Figure 4-3 shows the METER mode submenu.

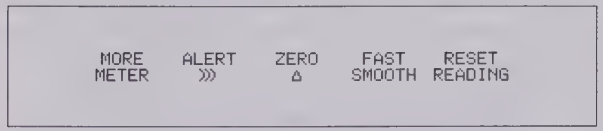



*Figure 4-3 METER Mode Submenus*

In METER, Ω, ⊣⊢, and EXT.mV modes you can choose the functions ALERT ))), Zero Δ, FAST/SMOOTH, and RESET READING directly with one of the function keys. Or you can find these functions in the Submenu MORE window. For more information about the SCOPE submenu, see Chapter 5.

The Submenu MORE window also offers advanced measurement adaptations, such as Scaling and Value Result. To open the window, press [F1]. Make your selections and press [F1] (CLOSE) to close the window.

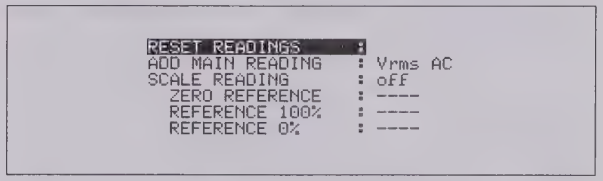



*Figure 4-4 More Meter Mode*

### Enabling and Disabling the Change Alert™ Function

Press [F2] to enable an audible alert signal. The test tool draws your attention with a beep when the measurement changes more than 100 digits. In Ω mode the alert warns you when the measurement falls to less than 5% of the measurement range.

### Changing the Refresh Rate of the Display

Select [F4] (FAST) to speed up the refresh rate in the measurement result display. A fast refresh rate is useful when you are making adjustments and must see the resulting reading as quickly as possible.

Select [F4] (SMOOTH) to average readings over the last measurements (8 seconds at 5 ms/div). It reduces the influence of noise or unstable input signals.

Select [F4] (no highlight) to get the normal readings.

## MAKING MEASUREMENTS IN METER AND EXT.mV MODE

In Meter and EXT.mV mode you can make the same measurements as found in the Measure Menu. To find these measurements, select ADD MAIN READING in the Submenu MORE window. This opens a list of all possible measurements. For more details of the measurements, see Chapter 3.

An easy way to return to the factory default readings of the active main mode is to press F5 (RESET READING) from the Submenu.

### Changing the number of readings

At the factory default setting the ScopeMeter test tool displays a combined numeric reading result and a waveform. You can customize the number of readings on the display from one to a maximum of four. On page 2 of the More window, highlight READINGS ON DISPLAY, select the new number 1, 2, 3, or 4, and press F5 to select. Then press F1 to remove the window again. In Ω and ⊣⊢ modes the maximum number of readings is two.

## TAKING RELATIVE READINGS (SCALING)

Scale Main Reading displays the present measurement result with respect to a defined range. From a Submenu, press F1 to open a MORE functions window. Next, use △ or ▽ to highlight SCALE READING. When you press F5, a list box appears on the display to select the scaling function: off, zero Δ (see F3), %Δ, and 0%-100%. Highlight a scaling function, and press F5 to select.

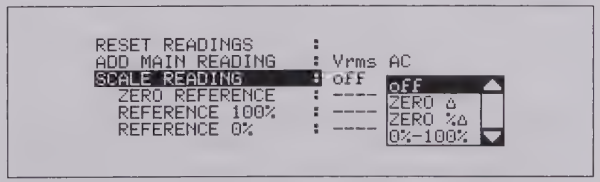



*Figure 4-5 Scaling Functions*

### Readings Relative to a Reference Point (Zero Δ)

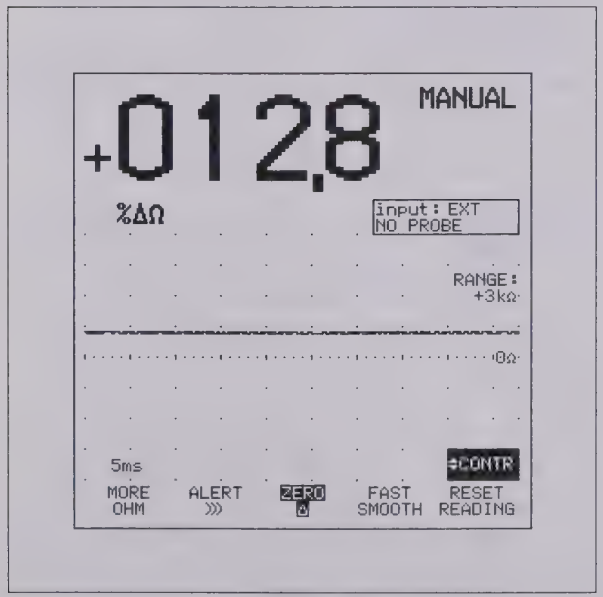
Select "ZERO Δ" to set the present upper reading as the zero reference point. Subsequent readings are displayed as units of variation from this point. This feature is useful when you need to monitor input activity in relation to a known good value. The zero function can also be used with dBV, dBm, or dBW.

You can also activate this function from the Submenu, and then press F3.

**Readings as a Percent Change from Reference Point (Zero %Δ)**

Select "ZERO %Δ" to set the present upper reading as the relative reference. Subsequent readings are displayed as a percentage of variation (delta) from this point.

The figure below shows percentage change (tolerance) when measuring a resistor:



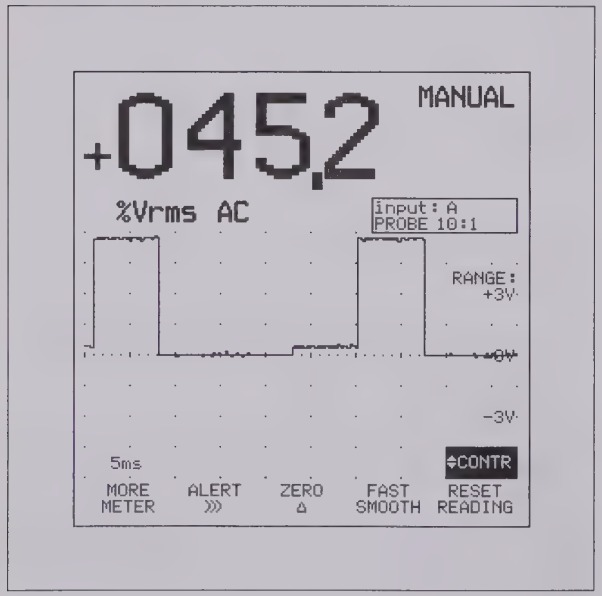

**Readings Displayed as a Percent of Scale (0%-100%)**

Scaling starts automatically when both 0% and 100% values have been entered as the scaled reference values. Use the following procedure (example for Meter mode):

1. From the SCALE READING list box, highlight 0%-100% and press F5.
2. Use ▲ ▼ to highlight REFERENCE 100% and press F5.
3. Measure the value that will represent 100%.
4. Highlight NOW (as the present 100% value) and press F5 to save the displayed value as 100%.
5. Repeat actions 2 to 4 for the 0% value.
6. Press F1 (CLOSE) to activate scaling and remove the window.

The present measurement result with respect to the defined range with a 0% and 100% value appears now as a scaled % readout.

A typical scaling display is shown in the figure below:




**Stop Scaling**

To stop scaling do one of the following:

- Choose another function.
- Highlight SCALE READING in the More window, press [F5], highlight "off", and press [F5].

**Readings Relative to a Minimum or Maximum Value (Min Max Zero Δ)**

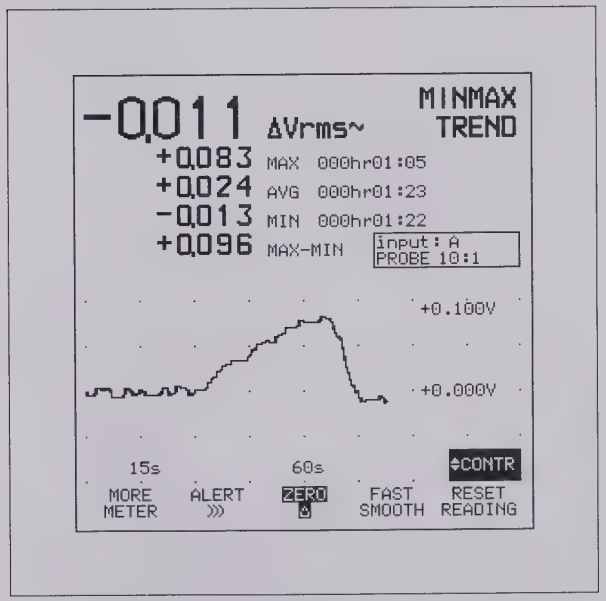
Min Max Zero Δ views the relative readings in units appropriate for the function and range selected. When in Min Max recording mode, set the test tool as follows:

1. From a Submenu, press [F3] (ZERO Δ).

Now the reading relative to the main value appears on the display.

*NOTE*

*In this example the Meter Min Max Zero is used.*




*NOTE*

*Scaling and Zero Δ selections are mutually exclusive; selecting one deactivates the other.*

**Scaling Using Minimum and Maximum Readings**

The MORE window also gives you access to a scaling function when the ScopeMeter test tool is in Min Max recording mode. First press [MIN MAX] to activate Min Max recording. Next, from a Submenu MORE window, use ▲ or ▼ to highlight SCALE READING. Then press [F5] to open the Scale list box.

*NOTE*

*In this example the Ohm Min Max Scaling is used.*

```
SCALE READING       : off
  ZERO REFERENCE    : ----
  REFERENCE 100%    : ----
  REFERENCE 0%      : ----
```

*Figure 4-6 Min Max Scaling Functions*

Min Max Scaling views the readings as relative percentage values. For example, you can determine how the existing reading relates as a percentage of a range defined by two of the following settings: **MIN**, **MAX**, **MAX-MIN**, and **AVG**. You would accomplish this from the Scale Reading list box as follows:

1. Use ▲ ▼ to highlight 0%-100% and press [F5].
2. Use ▲ ▼ to highlight REFERENCE 100% and press [F5].
3. Measure the signal. The maximum value represents the 100% value.
4. Highlight MAX and press [F5] to set the recorded maximum value as 100% reference.

5. Use ▲ ▼ to highlight REFERENCE 0% and press [F5].

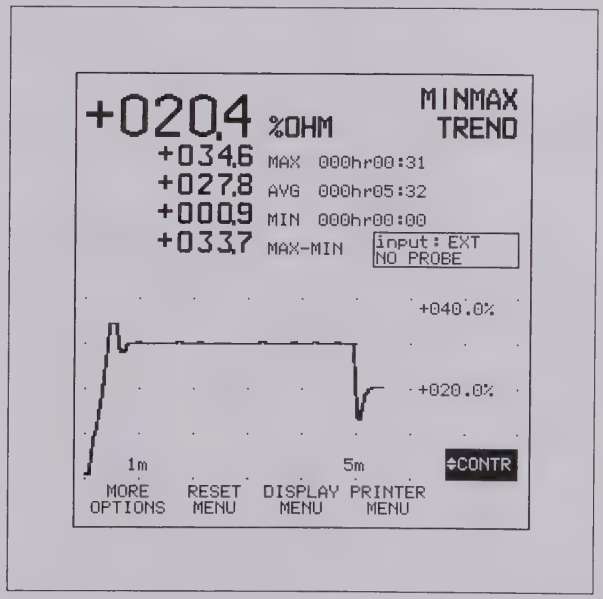
6. Measure the signal. The minimum value represents the 0% value.

7. Highlight MIN and press [F5] to set the recorded minimum value as 0% reference.

8. Press [F1] (CLOSE) to remove the window.

The Min Max Scaling is automatically activated.

Since these entries set up a valid range, the ScopeMeter test tool begins scaling with a display similar to the one in the following figure:



# Chapter 5
# Using in Scope Mode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## MAKING CONNECTIONS

Scope connections are illustrated in Figure 5-1.

⚠ Maximum scope inputs on either BNC are as follows:

- Maximum input signal voltage: 300V rms direct
- Maximum input signal voltage: 600V rms when using 10:1 probe
- Voltage to ground: 600V rms

Input impedance is 10 MΩ/15 pF with the 10:1 probe.

- Press [SCOPE METER] and [F1] to select the Scope mode.

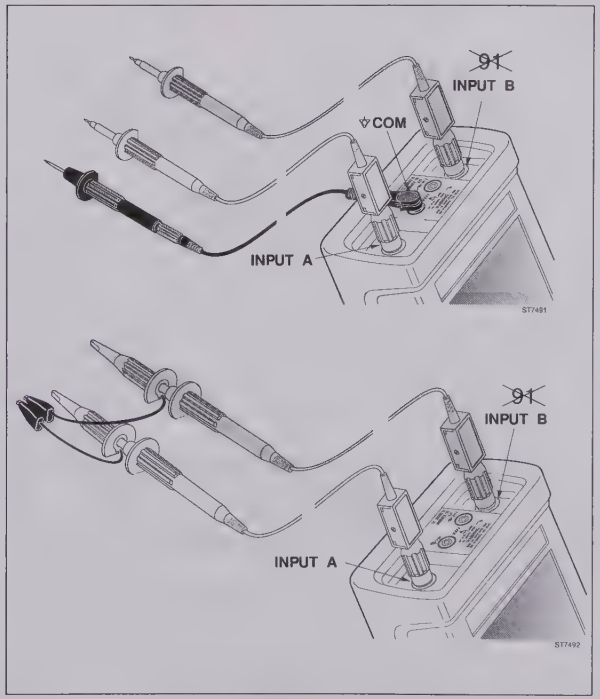



*Figure 5-1 Scope Connections*

## MAKING AN EASY SETUP

Continuous Auto Set automatically selects the optimum settings for connected input signals and keeps track of any variation of the signal. Start Continuous Auto Set by pressing [AUTO SET]. For most signals, the ScopeMeter test tool will automatically set inputs, amplitudes, time base setting, and triggering for an optimum display.

Pressing [AUTO SET] sets the following:

- INPUT A and/or INPUT B is switched on depending on signal input. All other waveform displays are switched off.
- Between two and five periods of the waveform with the lowest frequency are displayed.
- The attenuation per input is set so that the waveform occupies about four vertical divisions.
- The trigger source is chosen as the input signal with the lowest frequency.

If no triggerable waveform is found when you press [AUTO SET], approximate settings are used. If the input signal subsequently changes, the test tool readjusts itself; you will always have a meaningful picture on the display.

Continuous Auto Set can be configured through the [USER OPTIONS] Menu. Refer to Chapter 6 for a complete description.

## CONTROLLING INPUTS A AND B

Press [INPUT A] or [INPUT B] to open the input settings menu.

*Figure 5-2 Input A Menu*

### Selecting the Input

Press [F2] on the appropriate input to turn it on and off.

### Selecting the Input Coupling

Press [F3] on the appropriate input to select the input signal coupling. The selection is shown in the upper line of the top display.
**AC**-coupling allows for reading ac voltages above 40 Hz only. **DC**-coupling allows for reading ac and dc voltages.

The **GND** selection disconnects the input signal and displays the ground or zero level as a horizontal line. Ground provides a useful tool for setting up the display to show a high dc level or voltage spike. For example, if you anticipate a high positive dc level, select **GND** and press [MOVE ▽] to move the ground level lower on the display. A small marker box (▬) on the right side of the display identifies the ground level.

### Capturing Glitches

Press [F4] on INPUT A to turn GLITCH DETECTion on. This function displays the events that occur between two samples on INPUT A. INPUT B is turned off. The events can be glitches or other asynchronous waveforms that are 40 ns (nanoseconds) or wider.

*NOTE*

*GLITCH detection and AVERAGE are mutually exclusive.*

### Reversing the Polarity of the Displayed Waveform

Press [F1] to open the MORE INPUT window. Highlight INPUT A (or INPUT B) and press [F5] to open the list box. You can turn on and off an input and invert the INPUT A and INPUT B display.

**Invert** reverses the polarity of the displayed waveform. This is identified by the trace identifier on the display. For example, a negative-going waveform would be displayed as positive-going, providing a more meaningful viewing perspective in some cases.

## ADJUSTING THE AMPLITUDE

You can use [RANGE V] [mV RANGE] for INPUT A or INPUT B ~~91~~ to adjust input waveform attenuation. Sixteen ranges are available. A 1:1 probe can accommodate 1 mV to a maximum of 100V per division, and a 10:1 probe can accommodate 10 mV to a maximum of 1 kV per division. The amplitude can be changed in increments of 1, 2, and 5 (e.g., 100 mV, 200 mV, 500 mV). The upper row of the top display shows the range and the type of probe for each input.

When a 10:1 probe is used with the 10 mV or 20 mV range, averaging is turned on automatically. (**AVG 4** appears on the display.)

## ADJUSTING THE TIME BASE

Press [s TIME ns] to increase or decrease the number of periods. The time base readout is on the second row of the top display. Refer to Figure 5-3. Available settings depend on the acquisition mode in effect, and are as follows:

- Recurrent 10ns/DIV - 1s/DIV
- Single 100ns/DIV - 1s/DIV
- Roll 2s/DIV - 60s/DIV

The time base can be changed in increments of 1, 2, and 5 (e.g., 10 ns, 20 ns, 50 ns).

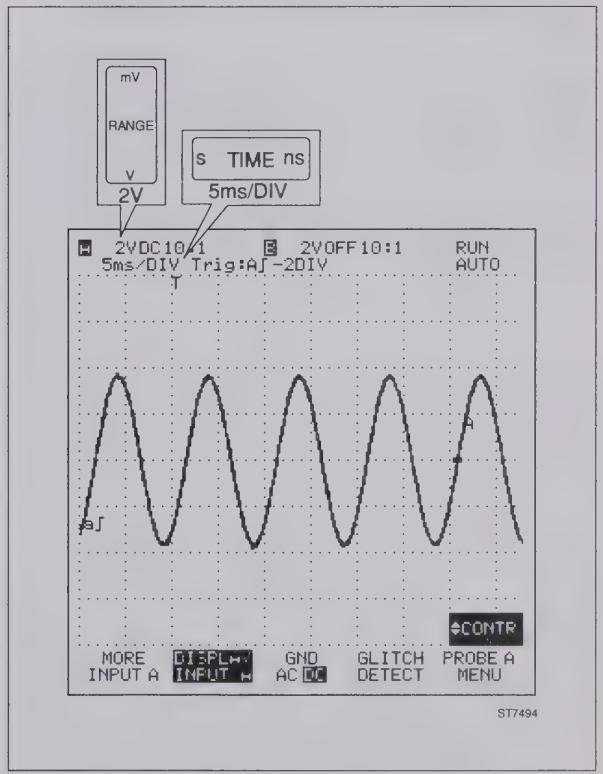



*Figure 5-3 Time Base and Amplitude Adjustment*

## POSITIONING THE WAVEFORM ON THE DISPLAY

Considerable flexibility is offered in moving the trace(s) around the display. [MOVE] and [MOVE] reposition the trace up or down four divisions. This operation can be done separately for each input. The [◁ MOVE ▷] key simultaneously repositions all traces left or right from -4 to +16.5 divisions. Waveform positioning is demonstrated in Figure 5-4.

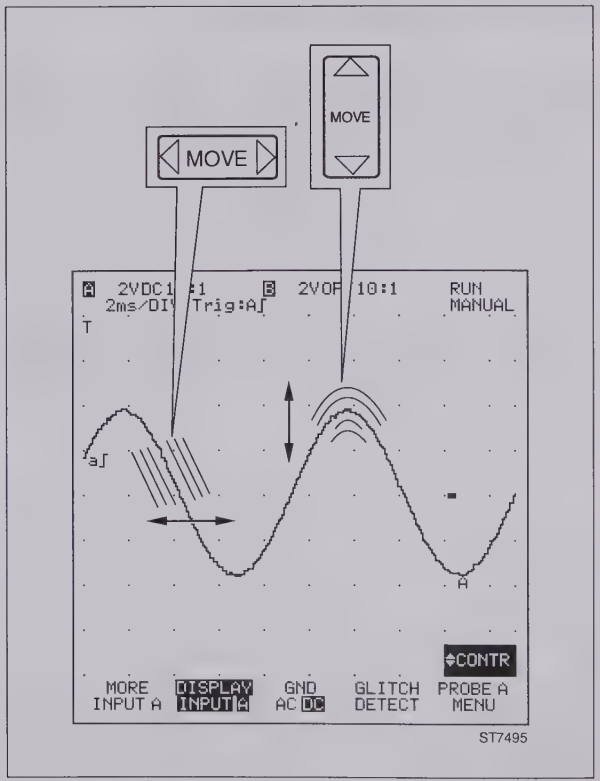



*Figure 5-4 Positioning the Waveform*

## ACQUIRING WAVEFORMS

### Choosing Recurrent or Single Acquisition

You can instruct the ScopeMeter test tool to continuously update its display, giving you a dynamic look at waveform activity as it occurs (**RECURRENT**). You can also tell the test tool to update its display only once, yielding a snapshot record of waveform activity (**SINGLE**), termed "Single-Shot" elsewhere in this manual.

From the Scope Submenu, press F2 to highlight RECURRENT for continuous display updates. Pressing HOLD RUN stops and starts an acquisition. A **HOLD** on the top right of the display indicates that acquisition is stopped. The time base range is 10ns/DIV to 1s/DIV.

Set up the ScopeMeter test tool for "Single-Shot" acquisitions with the following procedure:

1. Press F2 to select SINGLE (highlighted).
   **NO TRIG** begins flashing on the display. The instrument is waiting for a trigger.

   **RUN** appears on the display when the single acquisition is triggered. **HOLD** then reappears when acquisition is completed.

2. Now press HOLD RUN again and wait for another single acquisition trigger.

The time base range is 100ns/DIV to 1s/DIV.

### Roll Mode

Roll mode supplies a visual log of waveform activity and is especially useful when measuring lower frequency waveforms. To enter the Roll mode, press F2 to select RECURRENT, then press s TIME to select 2s/DIV, 5s/DIV, 10s/DIV, 20s/DIV, or 60s/DIV.

The waveform is now slowly traced on the display from left to right until the full screen is written. Then the trace slowly shifts from right to left like a pen-recorder. The Roll mode is automatically turned off if a time base of 1s/DIV or faster is selected.

Roll is an untriggered mode. The Capture length and Single-Shot functions are not available. However, the waveform can be frozen on the display by pressing HOLD RUN.

### Using "Zoom" to Increase or Decrease Time Resolution

Zoom displays a waveform with increased time resolution, giving up to 1000x magnification. Use the following procedure to Zoom in a waveform:

1. Press [▲▼]
2. Use the △ and ▽ keys to highlight "scope zoom".
3. Press [F5] to select. ▲▼ZOOM appears in the right bottom of the display.
4. Press △ to enlarge the waveform (speed up the time base) or press ▽ to shrink the waveform (slow down the time base).

The ScopeMeter test tool zooms in and out one step at a time and, if necessary, the trigger delay is recalculated. The focal point for this activity is waveform activity at the fourth time division. The zoom feature is useful as a quick examination of a live waveform. Zoom cannot be used on saved waveforms recalled from memory or when the waveform is frozen (HOLD).

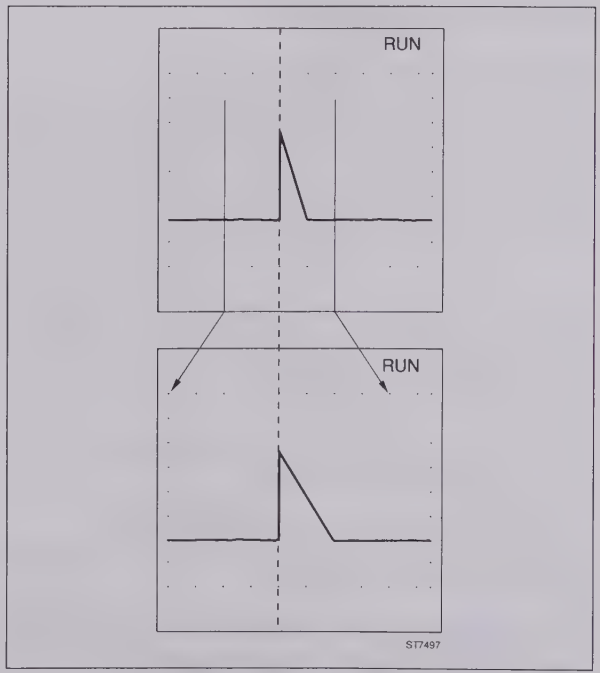



*Figure 5-5 Zoom in a Waveform*

## SELECTING THE SCOPE SUBMENU

From the Scope mode, press [SUB MENU] to open the Scope mode submenu. This gives you more control over the Scope mode. Figure 5-6 shows the Scope Submenu.

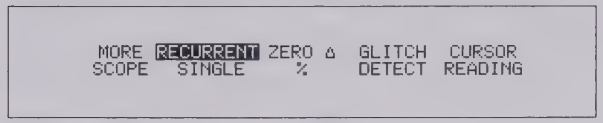



*Figure 5-6 Scope Submenu*

Refer to Chapter 6 for descriptions of the [F3] (ZERO Δ) and [F5] (CURSOR READING) function key.

The MORE Scope window gives you access to all control over the Scope mode. In addition to the functions shown in Figure 5-6, you will also find functions, such as Capture Length, Average Waveforms, and Scope measurements. To use these functions, press [F1] to open the MORE SCOPE window.

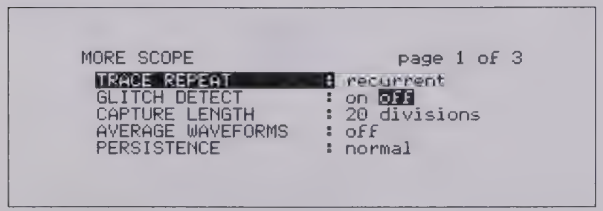

MORE SCOPE page 1 of 3
TRACE REPEAT : recurrent
GLITCH DETECT : on off
CAPTURE LENGTH : 20 divisions
AVERAGE WAVEFORMS : off
PERSISTENCE : normal

*Figure 5-7 More Scope Window*

**Capturing 10 or 20 Divisions**

This enables you to capture either 10 or 20 divisions of waveform detail.

Selecting 10 divisions, or one full screen, is sufficient for most applications.

For fast single shots, selecting 20 divisions enables you to capture more information, but on slow waveforms it lowers the screen update speed by a factor of 2. Now you can use [◁ MOVE ▷] to move the acquired waveform right and left across the display.

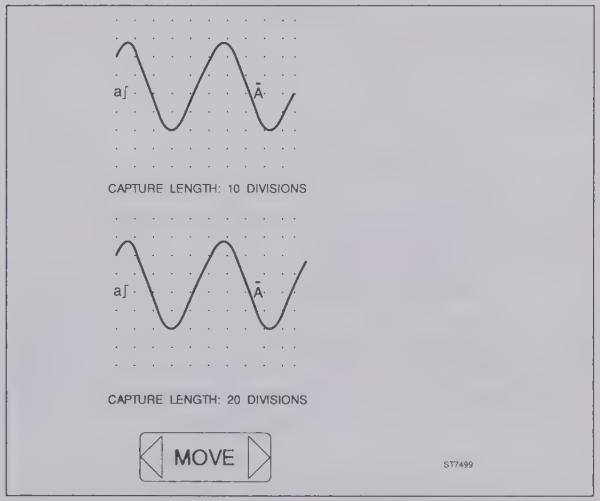



*Figure 5-8 Capture length*

### Smoothing the Waveform (Average)

The test tool can average multiple samples of a waveform, allowing for noise suppression without loss of bandwidth. To select average in the Scope mode, do the following:

1. From the More Scope window, highlight AVERAGE WAVEFORMS.
2. Press F5 to open the list box.
3. Use ▲ ▼ to choose the number of waveforms to average for each display update. The maximum number is 256.
4. Press F5 to select.
5. Press F1 (CLOSE) to close the window.

To turn off averaging, set AVERAGE WAVEFORMS to be off again.

*NOTE*

***AVERAGE WAVEFORMS: OFF** changes to **AVERAGE WAVEFORMS: by 4** in the 10 mV and 20 mV attenuator ranges when a 10:1 probe is used. Averaging and Glitch detect (on INPUT A) are mutually exclusive.*

Additional information about smoothing appears in Chapter 6. Waveform samples with and without averaging are shown in Figure 5-9.

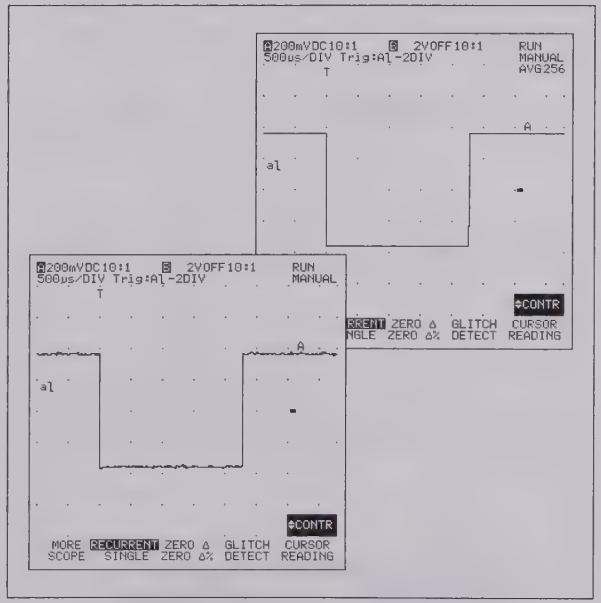



*Figure 5-9 Averaging*

## TRIGGERING

### Trigger Basics

Triggering tells the ScopeMeter test tool when to begin displaying the waveform. You can select which input signal should be used as the source, on which edge this should occur, and at what waveform level it should occur. Finally, you can tell the test tool to delay the waveform to be displayed with a specified time delay, number of cycles, or number of events.

The second top row on the display identifies the trigger parameters being used. Trigger icons on the display indicate the position of the trigger delay and the trigger level. Refer to Figure 5-10.

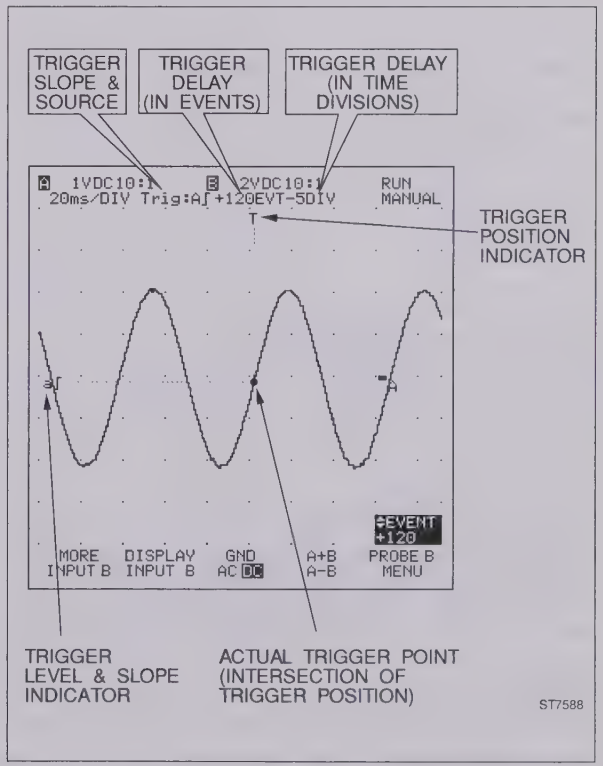



*Figure 5-10 Display with All Trigger Information*

For example,

**20 ms/DIV TRIG:A⌠** +120EVT -5DIV

means that INPUT A is used as the trigger source with a positive slope. The amount of trigger delay in time divisions is -5, and that the amount of trigger delay in events is +120.

- Press [TRIGGER] to open the Trigger menu.

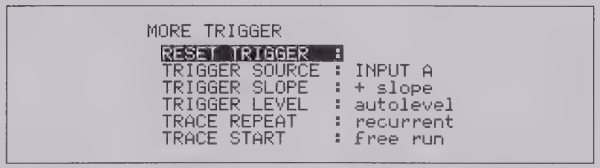

MORE TRIGGER
RESET TRIGGER :
TRIGGER SOURCE : INPUT A
TRIGGER SLOPE : + slope
TRIGGER LEVEL : autolevel
TRACE REPEAT : recurrent
TRACE START : free run

*Figure 5-11 Trigger Menu*

### Selecting a Trigger Source

Press [F1] to enter the MORE TRIGGER window, then highlight TRIGGER SOURCE and press [F5] to open the list box. Select one of the following trigger sources: INPUT A, INPUT B ~~91~~, EXTERN 2V (via external trigger input), EXTERN 0.2V (via external trigger input), or GENERATOR ~~91~~ ~~92~~ ~~96~~ (via internal waveform generator).

*NOTE*

*You can also find the trigger source selection under the appropriate INPUT A or INPUT B More window.*

- EXTERN 2V or EXTERN 0.2V are available as trigger source selections. You can connect an external trigger at the red 4-mm banana jack or use the PM9081 Banana-to-BNC adapter supplied. Make your selection for the appropriate TTL-compatible (Transistor-to-Transistor Logic) trigger level (0.2V or 2V).

- GENERATOR ~~91~~ ~~92~~ ~~96~~ . See Chapter 6 for more information.

*NOTE*

*EXTERN and GENERATOR are mutually exclusive; selecting one deactivates the other.*

### Defining the Trace Start

Highlight TRACE START and press [F5] to open the list box.

When **Wait for trigger** is selected, the test tool needs a trigger to display a waveform.

When **free run** is selected, and if no trigger is detected for 100 ms, the test tool provides its own trigger and the trace still appears on the display. Use this mode for a continuous display of a waveform.

### Selecting a Trigger Slope

From the Trigger menu, press [F2] to select triggering on either the +SLOPE or -SLOPE of the chosen input.

**Selecting a Trigger Level**

Press F4 to open the ADJUST LEVEL box. If you have selected INPUT A or INPUT B as the trigger source, you can use ▲ and ▼ to adjust the trigger level continuously. Observe the level changes in the display. Press F1 to select.

The trigger level is identified by the trigger icon (e.g., ⊐l) on the left of the display.

**Selecting Auto Level**

Press F5 to find the optimal trigger level for the source waveform voltage.

**Choosing a Trigger Delay**

You can also begin to display the waveform at some time before or after the trigger point is detected. This is identified by the delay icon "T" on the top of the display.

From the second page of the MORE TRIGGER window, select RESET DELAY to reset all the selected trigger delays to their initial values (TIME DELAY : -2, TRIGGER SPECIAL DELAY: OFF).

Types of trigger delays are discussed below. In many instances, you can select more than one type of delay.

Press F3 to enter the Time Delay list box. Use ▲ or ▼ to set the trigger time delay in increments of the existing time base divisions. The range of divisions is -20 to +640. For example, if the time base is set to 2ms/DIV, +16 defines a delay of 16 time divisions (32 milliseconds) after the trigger is detected. Press F5 to select.

From the second page of the MORE TRIGGER window, select SPECIAL TRIGGER DELAY (none, Events, or N-Cycle).

**N-CYCLE** The trigger waveform is divided by the number of cycles "N" to create a stable picture for waveforms with a cyclic character. (N-CYCLE can be used only on INPUT A.) Use ▲ or ▼ to select the number of cycles. A total of +2 to +255 cycles can be selected.

**EVENTS** Triggering via the external input is delayed for a number of events that occur on INPUT A. Use ▲ or ▼ to select the number of events (+1 to +1023). External trigger starts the delay, and after the number of events on INPUT A is equal to the selected number, the test tool acquires the INPUT A signal.

## DISPLAYING THE MINIMUM AND MAXIMUM OF A WAVEFORM

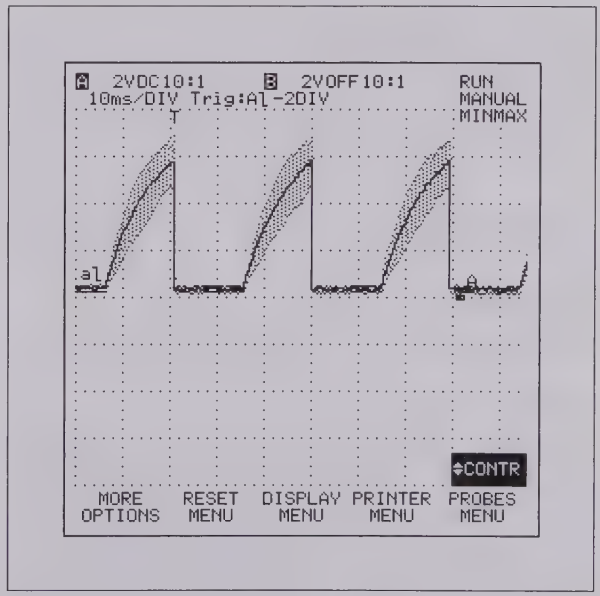
The ScopeMeter test tool records the envelopes (minimum and maximum values) of the live waveforms A and B and A±B. (INPUT B not in FLUKE 91).

Press [MIN MAX] to activate the Min Max envelope mode. **MIN MAX** now appears on the top right of the display.

The minimum and maximum values are automatically saved in waveform memories. The display shows the resultant envelope in lower intensity (grey) together with the actual waveform. Any change in attenuation or time base will restart a new Min Max envelope action.
The function is turned off with one of the following actions:

- Press [MIN MAX] a second time.
- Press [AUTO SET].

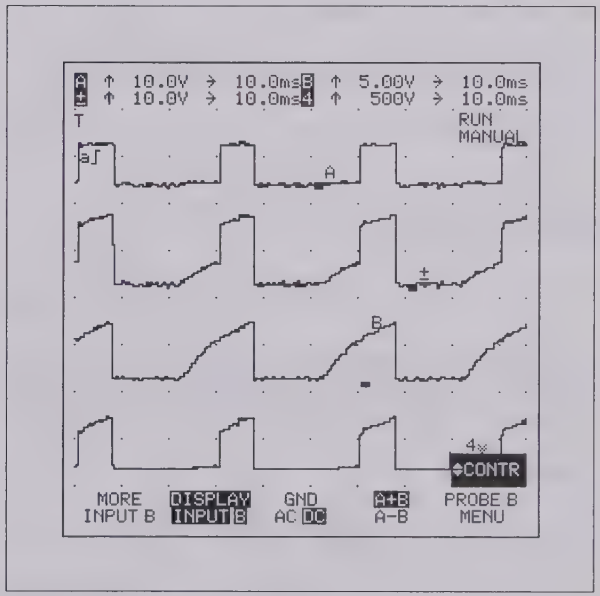
You can use Min Max envelope to observe variations in time or amplitude of input signals over a longer period of time.



## MAKING COMBINATIONS WITH INPUT A AND INPUT B

Press [F4] on INPUT B to select A+B to show INPUTS A and B added together or to select A-B to show INPUT B subtracted from INPUT A.

You can also choose A+B and A-B from the MORE INPUT A or MORE INPUT B window. Highlight COMBINE A & B, and press [F5] to open the list box. You can also select **A versus B** to provide a plot with INPUT A on the vertical axis and INPUT B on the horizontal axis. Press [F5] to activate your selection.




## DISPLAYING MULTIPLE WAVEFORMS

By displaying a combination of live and recalled waveforms, the test tool can display a maximum of four waveforms simultaneously. For example, INPUTS A, B, A+B, and waveforms recalled from memory could be displayed. You can display any combination of four waveforms.

If you attempt to display a fifth waveform, a message on the display lets you know that you exceeded the maximum number of four waveforms.

*NOTE*

*The A versus B display is not counted in the four-trace maximum.*

## ADAPTING THE DISPLAY

You can adapt the display to your preference as follows:

1. Press [USER OPTIONS].
2. Press [F3] to open the Display Menu window.

### Selecting a Dot Size

3. Use ▲ ▼ to highlight DOT SIZE and press [F5] to open the list box.
4. Choose a dotsize: SMALL, MEDIUM, or LARGE and press [F5] to select. This selects the trace to be single, double, or triple width.

### Selecting a Display Grid

5. Use ▲ ▼ to highlight SCOPE GRID and press [F5] to open the list box.
6. Use ▲ ▼ to choose between FULL, QUADRANT, or BORDER. Press [F5] to select any of the three.

BORDER provides time and amplitude division marks around the display.
QUADRANT adds horizontal and vertical division points as added reference points to the border display.
FULL adds a crosshatch pattern based on the horizontal time and vertical amplitude divisions on the display.

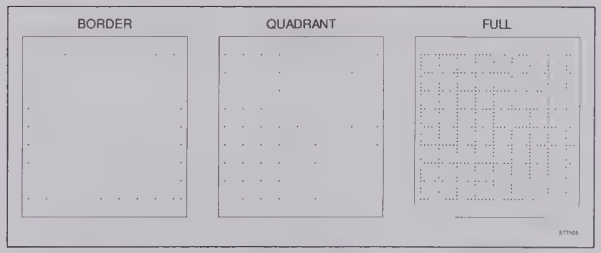



*Figure 5-12 Grid Selection*

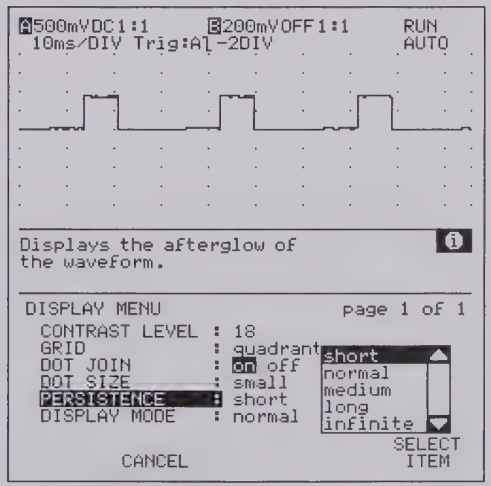
### Adjusting the Trace Quality

7. Use ▼ to highlight PERSISTENCE, and press [F5] to open the list box.

Persistence improves the trace quality when you measure on complex waveforms. Choose one of the five persistence states: **short**, **normal**, **medium**, **high**, or **infinite** to obtain the best image on the display. Press [F5] to select. Initially the ScopeMeter test tool is set to normal persistence.

*NOTE*

*Contrast and Persistence work interactively. So when you readjust persistence, it may be necessary to choose another contrast again.*




In the DISPLAY window you can also choose the DOT JOIN function, which either shows the individual measurement samples or joins them together to give a continuous trace.
DISPLAY MODE allows you to select normal or reverse video.

8. Press F1 (CLOSE) to remove the window. The test tool displays the USER OPTIONS menu again.

## MORE INFORMATION

Chapter 8 (ScopeMeter Test Tool Tutorial) presents Scope mode applications that use many of the features discussed in this chapter. Refer to Chapter 6 for a discussion of additional capabilities.

# Chapter 6
# Using Additional Capabilities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## MAKING MEASUREMENTS USING THE CURSORS ~~91~~ ~~92~~

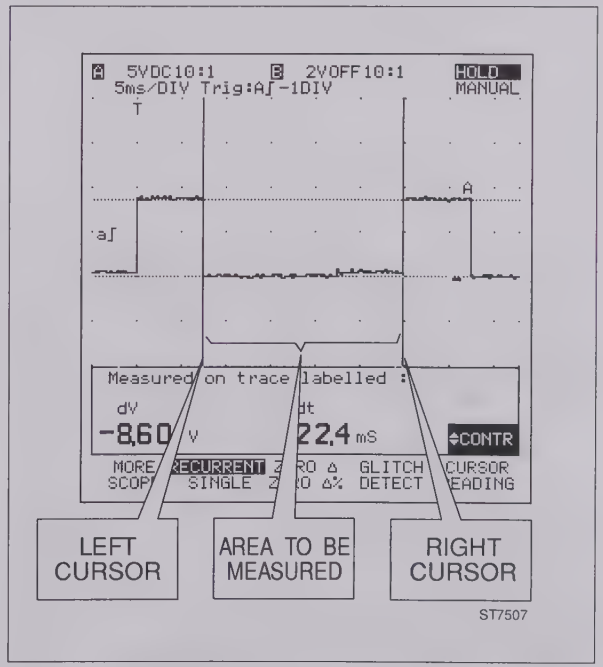
The Cursors allow you to make precise digital measurements of waveform activity between measurement areas. This can be done on live waveforms and on saved waveforms.

- From Scope mode, press [SUB MENU] [F5] to turn on (and off) the cursor readings.

Active cursors appear on the display as two vertical and two horizontal lines.

The intersection of vertical and horizontal lines of the left cursor marks a point on the waveform. The intersection of vertical and horizontal lines of the right cursor marks another point on the waveform. The measurement takes place between these two points.

Use [◁ LEFT CURSOR ▷] and [◁ RIGHT CURSOR ▷] to move the left and right cursors which designates the area for the cursor measurement.




*NOTE*

*You can also find many cursor measurements when using the [MEASURE MENU] key. These measurements are explained in Chapter 3.*

When the cursor readings are turned on, you can choose one or more measurements as follows:

1. From Scope mode, press SUB MENU F1 to open to the More Scope window.

2. From the second screen page of the More Scope window, highlight ADD MAIN READING. Press F5 to open the list box. The ADD MAIN READING list box allows you to choose which cursor measurement reading to display. A list of possible measurements is shown in Figure 6-1.

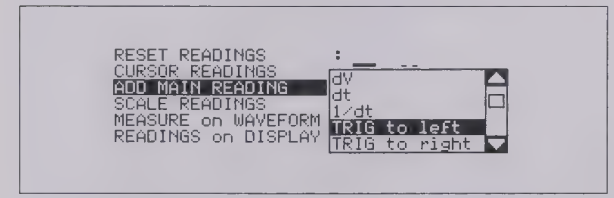



*Figure 6-1 Cursor Measurements Window*

3. Choose the type of Scaling Reading: off, ZERO Δ, or %
   off displays the measurement results in normal values.
   ZERO Δ displays a change to the reference value.
   % displays a change to the reference value as a percentage.

4. Choose the waveform source with Measure on Waveform. The source selection is determined by active display traces. The traces can be obtained from the active display (A, B, A±B) or from waveform memory.

5. Choose the number of Readings; the test tool can display up to five cursor readings at the same time.
   When you choose another main readings, all readings will shift down one, and your last chosen measurement is placed on top. Notice that the bottom reading is then removed from the display.

**Using the Markers**

Use the marker to identify the point on the waveform that a measurement has occurred or is expected to occur. The marker appears on the waveform as an "X".

6. From the third screen page of the More Scope window, press F5 to open the Markers list box. A list box of markers in use is shown in Figure 6-2. Use ↑ or ↓ to choose the marker. Press F5 to select.

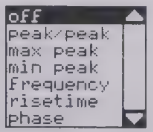
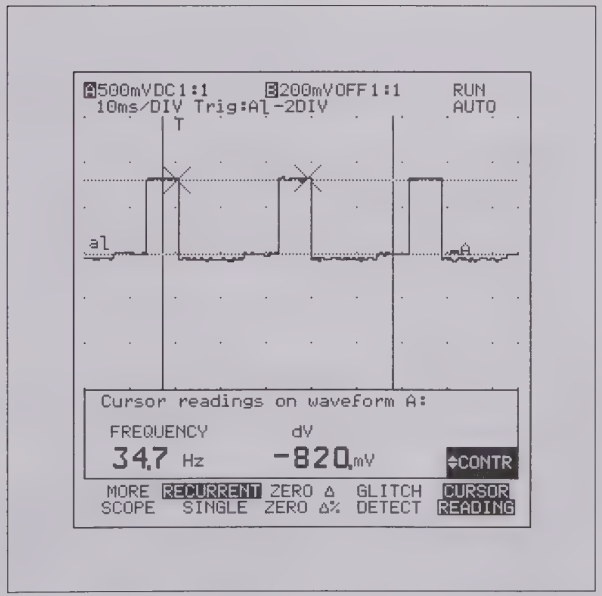



*Figure 6-2 Markers List Box*


A 500mV DC 1:1 B 200mV OFF 1:1 RUN
10ms/DIV Trig:A -2DIV AUTO
Cursor readings on waveform A:
FREQUENCY dV
34.7 Hz -820 mV
CONTR
MORE SCOPE RECURRENT SINGLE ZERO Δ ZERO Δ% GLITCH DETECT CURSOR READING

In this example, the markers are defining sample points for measuring frequency.

*NOTE*

*Markers may be easier to see when you press* HOLD RUN *and freeze the waveform.*

7. Press F1 to close the window.

**Adding a Cursor Main Reading**

From the ADD MAIN READING list box, use ▲ or ▼ to highlight the reading to display, then press F5 to select. Repeat this for more readings.

In making cursor measurement calculations, the ScopeMeter test tool uses waveform activity between the cursors.

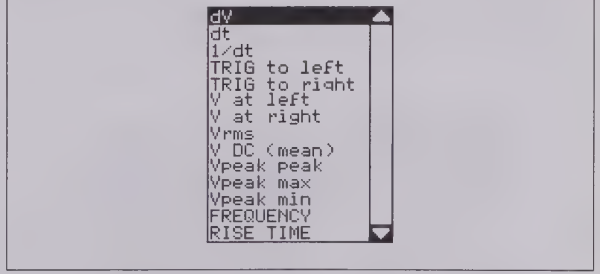
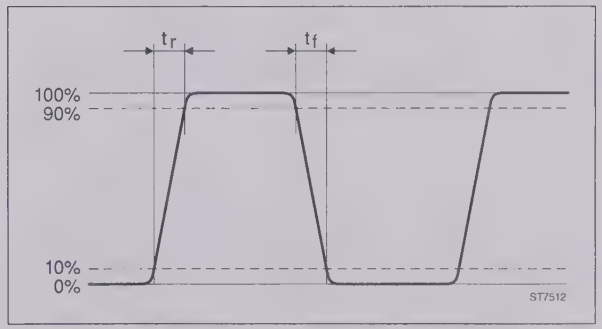



*Figure 6-3 Cursor Main Readings List Box*

The measurement results are displayed in the bottom display area. A maximum of five measuring functions can be turned on at the same time.

- **dV** (for delta volts) Measures the voltage difference between the cursors.
- **dt** (for delta time) Measures the time difference between the cursors.

- **1/dt** (for relative frequency) Shows the reciprocal value of dt.
- **TRIG to left** Measures the time difference between the trigger occurrence and the left cursor.
- **TRIG to right** Measures the time difference between the trigger occurrence and the right cursor.
- **V at left** Measures the voltage amplitude where the left cursor crosses the waveform.
- **V at right** Measures the voltage amplitude where the right cursor crosses the waveform.
- **Vrms** Measures the Root Mean Square (rms) voltage between the cursors.
- **V DC (mean)** Measures the MEAN (average of readings) value of waveform between the cursors.
- **Vpeak/peak** Measures the PEAK to PEAK value of the waveform between the cursors.
- **Vmax peak** Measures the maximum peak value of the waveform between the cursors.
- **Vmin peak** Measures the minimum peak value of the waveform between the cursors.
- **frequency** Measures the frequency of the waveform between the cursors. At least $1^1/_2$ cycles of this waveform must occur between the cursors. You can scroll a waveform through the cursors by pressing ◁ MOVE ▷. Read the frequency change in the bottom display.
- **rise time** Measures the rise time between 10% and 90% points of the waveform. The 0% and 100% points are determined by the intersection of the waveform and the vertical cursors. Set the rising slope to at least four time divisions for a precise measurement.




- **phase** Measures the phase shift between two waveforms. You can select upto three waveforms for phase measurements to a reference waveform.

## DELETING MEMORIES ~~91~~ ~~92~~

Open the Delete Menu at any time by pressing [SAVE] and [F5].

```
DELETE ALL Screen Memory contents
DELETE ALL Waveform Memory contents
DELETE ALL Setup Memory contents
DELETE ALL Memory contents
```

*Figure 6-4 Delete Memory List Box*

You can now delete all memories or selected memories (Screen memories, Waveform memories, or Setup memories). A message appears prompting you to confirm that you want to delete all memory.

### CAUTION

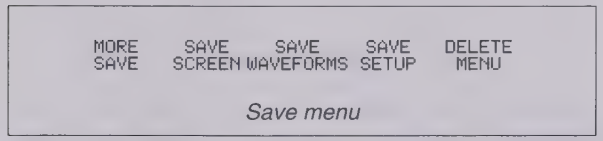
**A Master Reset destroys all memory contents and leaves initial setup with its default settings. Refer to "Master Reset configuration" further on in this chapter for a complete discussion of Initial Setup.**

You can also delete a single memory location. From the More Save window, first choose the type of memory (DELETE what?) you want to delete: Screen, Waveform, or Setup memory. Press [F5] (SELECT ITEM) to open a list box and choose the memory location you want to delete. Use ⌃ or ⌄ to highlight the memory number. Press [F5] to delete the selected memory location.

## SAVING TO MEMORY ~~91~~ ~~92~~

You can save screens, waveforms, and setups to memory, copy them between memories, and recall them from memory. Ten nonvolatile Screen memories, 20 nonvolatile Waveform memories, and 40 nonvolatile Setup memories are available. (For FLUKE 96 you can save five nonvolatile Screen memories, 10 nonvolatile Waveform memories, and 20 nonvolatile Setup memories).

- Press [SAVE] to open the Save to Memory menu.




*Save menu*

### Saving a Screen

Use this function to save the current active display image for future reference. You can save a maximum of 10 screens (For FLUKE 96 you can save a maximum of five screens).

- Press [F2] (SAVE SCREEN) to save the current screen in memory (memory #).

The test tool automatically uses the next available memory location. The display continues to show the actual input waveform.

*NOTE*

*When Medium, Long, or Infinite persistence has been chosen, you will only save the actual waveform information.*

### Saving Acquired Waveforms

Use this function to save acquired waveforms on INPUT A, INPUT B, and A±B in Scope mode, needed for future measurements. You can save a maximum of 20 waveforms (For FLUKE 96 you can save a maximum of 10 waveforms).

- Press [F3] (SAVE WAVEFORM).

The test tool starts automatically with the next available memory locations.

### Saving a Setup

Use this function to save your keystroke sequences. Once the test tool is set up to make the required measurement, you can save this configuration as one of a maximum of 40 setups (For FLUKE 96 you can save a maximum of 20 setups). A setup is simply the current operating configuration of your ScopeMeter test tool.

- Press [F4] (SAVE SETUP).

The test tool starts automatically with the next available memory.

### Copying Waveforms or Settings

To copy a waveform or setting from one memory to another, press [F1] to open the More Save window.

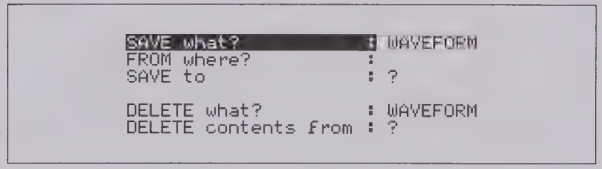



*Figure 6-5 More Save Window*

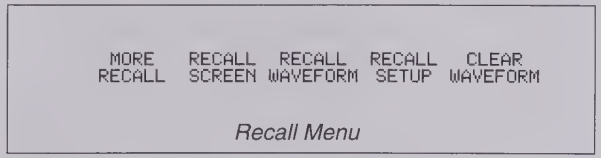
First choose what you want to copy, a waveform or a setting. Then determine from which memory you want to copy. On pressing [F5] (SELECT ITEM), you must choose the memory to which you want to copy. The test tool starts automatically with the next available memory.

Use this function to organize the sequence of your waveforms or settings. This can be useful in semi-automatic measurements.

## RECALLING FROM MEMORY ~~91~~ ~~92~~

You can review screens and recall waveforms and setups from memory at any time.

- Press [RECALL] to open the Recall from Memory menu.




*Recall Menu*

### CAUTION

**A Master Reset destroys all memory contents and leaves the initial setup with its default settings. Refer to "Master Reset configuration" further on in this chapter for a complete discussion of Initial Setup.**

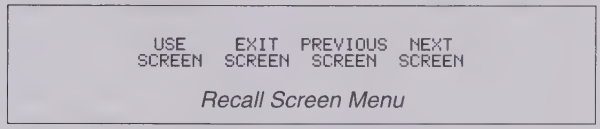
### Recalling a Screen

You can display already saved screens with related setups. This is presented as a picture that can no longer be changed. Use this when you want to view a measurement later.

1. Press [F2] (RECALL SCREEN) to view a saved screen from screen memory (memory #).
   At the same time the Recall Screen function key menu is activated.

2. Use F3 (PREVIOUS SCREEN) or F4 (NEXT SCREEN) to step through the saved screens.

3. Press F1 to replace the actual setup with the recalled setup that belongs to the saved screen.




*Recall Screen Menu*

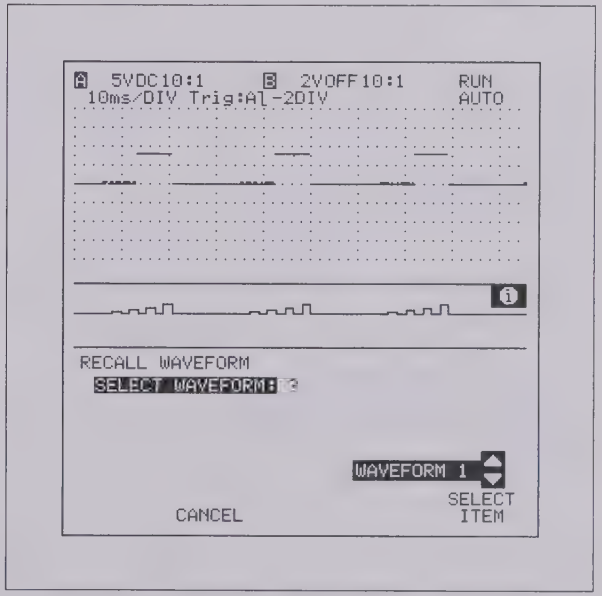
**Recalling a Waveform**

1. Press F3 (RECALL WAVEFORM) to recall a saved waveform from waveform memory. A list of all used waveform memories now appears.

2. Use ▲ and ▼ to highlight the required waveform. The View Area displays the saved waveform in compressed form.

3. Press F5 to recall the selected waveform. A displayed memory waveform is indicated with the waveform memory number.

You can display a maximum of four waveforms at a time. If you attempt to display a fifth waveform, a message lets you know you have exceeded the maximum number allowed and suggests that you remove the oldest recalled waveform.

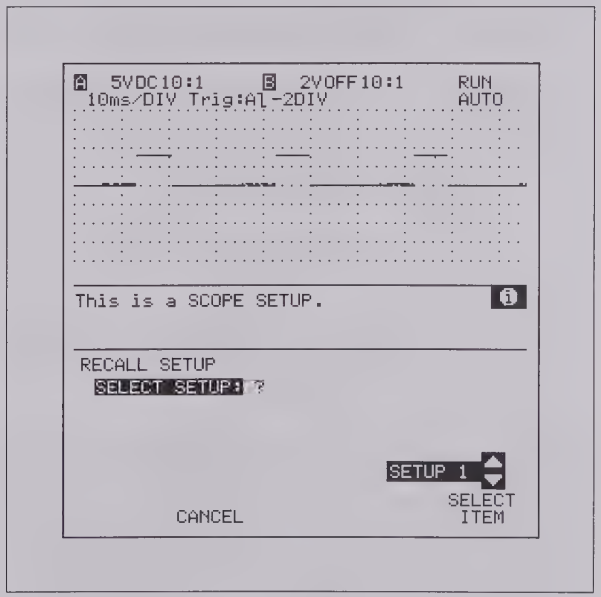


To reposition any of the recalled waveforms on the display, first select the appropriate waveform separately by pressing [↕], highlight "move #" in the list box with △ and ▽, and press [F5] to select. ↕MOVE appears in the right bottom of the display. Now use △ and ▽ to reposition the waveform.

Press [F5] (CLEAR WAVEFORM) to remove all recalled waveforms from the display. The live waveforms (A, B, and A±B) remain displayed, and the present setup configuration will not change.

**Recalling a Setup Configuration**

- Press [F4] (RECALL SETUP) to recall a saved setup configuration from setup memory. A list of all used setup memories now appears.
- Use △ or ▽ to highlight the required setup.
- Press [F5] to recall the selected setup, that replaces the present setup configuration.



## USING WAVEFORM MATH FUNCTIONS

~~91~~ ~~92~~ ~~96~~

You can perform several math functions on the various waveforms or memories.

- **ADD**, **SUBTRACT**, and **MULTIPLY** require two operands (SOURCE 1 and SOURCE 2). The operands can be selected from acquisition memories or waveform memories.
- **INVERT**, **INTEGRATE**, and **FILTER** require one operand (SOURCE 1) from acquisition memories or waveform memories.
- All operations require a **DESTINATION** waveform memory selection.

*NOTE*

*Leaving the Math function active will cause a continuous update of the destination memory if the source(s) are active waveform(s).*

1. Press [SPECIAL FUNCT] to open the Special Functions menu.
2. Press [F3] to open the MATH menu.
3. Start or stop the math function by turning the MATH FUNCTION on or off.
4. The MATH OPERATION list box lists all math operations available. Choose one and press [F5] to select.
5. Use ▲ ▼ to highlight the source(s) and destination items. Press [F5] to open the list boxes. Now choose the source(s) and destination. Press [F5] to select.

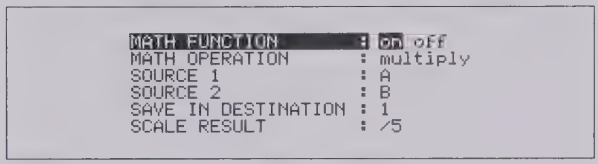



*Figure 6-6 Math Window for Multiply*

### Scaling the Display

The Scale factor allows you to adjust the display to accommodate the math result. Use ▲ or ▼ to highlight SCALE RESULT, and press [F5] to open the list box. You can now use ▲ and ▼ to highlight: off, /5, /25, or /125, and press [F5] to select.

### Choosing a Math Operation

You can choose from the following six math operations:

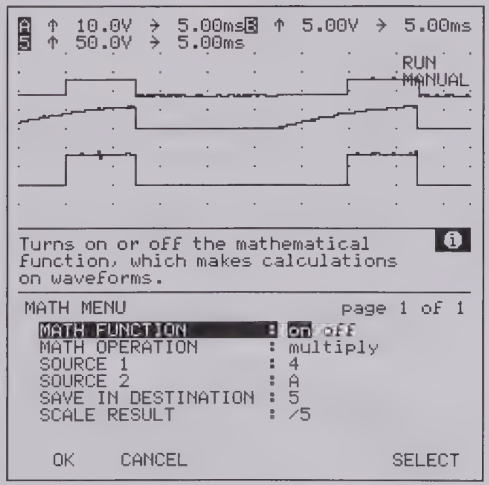
**Add** Adds two waveforms (each sourced from an active input or a memory location) and stores the result in a waveform memory. For example, waveforms from INPUT A (SOURCE 1) and Waveform 1 (SOURCE 2) can be added, resulting in a waveform stored in Waveform 4 memory (DESTINATION).

**Subtract** Subtracts the SOURCE 2 waveform from the SOURCE 1 waveform and stores the result in the next free waveform memory. As with ADD, active inputs or memory locations can be used in any combination for the sources.

**Multiply** Multiplies two waveforms (each sourced from an active input or a memory location) and stores the result in the next free waveform memory. For example, power can be calculated with MULTIPLY if SOURCE1 represents the voltage drop across a device and SOURCE 2 represents current through that device. In the following Figure, waveforms from Waveform 4 memory (upper) and INPUT A (middle) are multiplied, resulting in the waveform stored in Waveform 5 memory (lower).

**Invert** INVERT allows you to reverse the polarity on an active input or memory waveform and store the new waveform in another memory location.

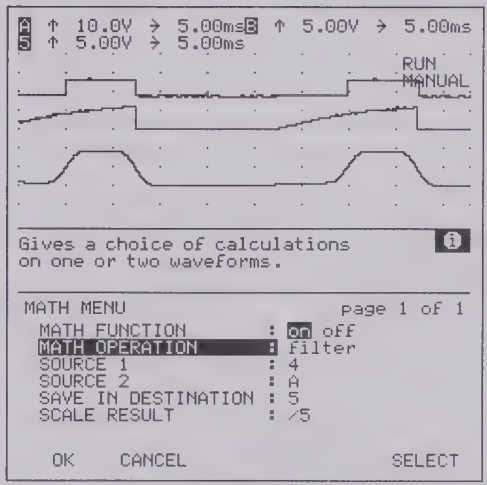
**Integrate** This function calculates and displays the area of the selected waveform. Integrate allows you to totalize the waveform over a period of time, showing the real power dissipation when the waveform changes levels.


A ↑ 10.0V → 5.00ms B ↑ 5.00V → 5.00ms
5 ↑ 50.0V → 5.00ms
RUN
MANUAL
Turns on or off the mathematical function, which makes calculations on waveforms.
MATH MENU
page 1 of 1
MATH FUNCTION : on off
MATH OPERATION : multiply
SOURCE 1 : 4
SOURCE 2 : A
SAVE IN DESTINATION : 5
SCALE RESULT : /5
OK
CANCEL
SELECT

**Filter** Any waveform (active input or memory) can be filtered, with the resulting waveform stored in a new memory location. Noise suppression or simply waveform smoothing is thereby possible. Filtering is especially useful with single-shot waveforms, where averaging of multiple waveform samples is not otherwise available. In the following figure, the upper waveform represents the INPUT A waveform as measured, and the lower waveform represents the filtered version recalled from Waveform 4 memory.

*NOTE*

*In FILTER function, the -3 dB frequency is 0.8/time-per-division.*



## USING A PRINTER ~~91~~ ~~92~~

### Connecting to a Printer

Use the Optically Isolated RS-232 Adapter/Cable (PM9080/001) to connect a printer to the OPTICAL INTERFACE connection of the ScopeMeter test tool. See Figure 6-7. This Adapter/Cable is an option available by ordering the PM9080/001 from your FLUKE representative.

### CAUTION

**Ensure that the printer is turned off during installation. This prevents damage to the printer.**

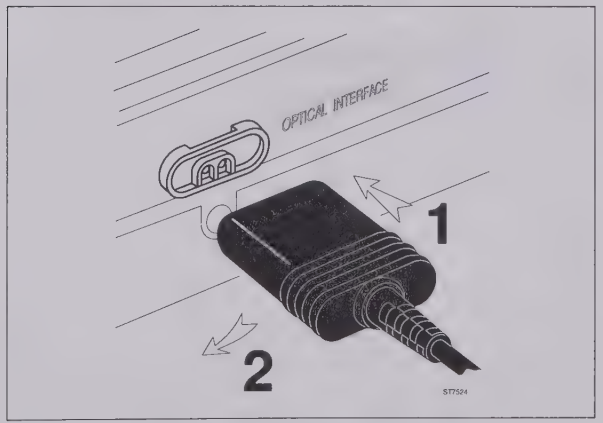



*Figure 6-7 PM9080/001 Hookup*

*NOTE*

*The following instructions relate to actions you must take at the test tool end of this operation. For more information about advised printer setup parameters, see Appendix 10D.*

### Setting Print Parameters

Press USER OPTIONS and then F4 to open the Printer window. You can now choose the printer settings and type of information to print.

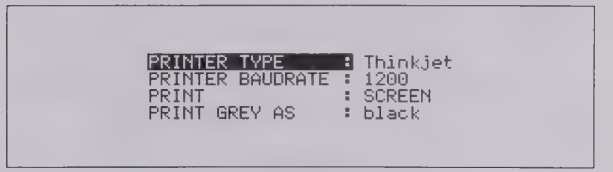



*Figure 6-8 Printer Window*

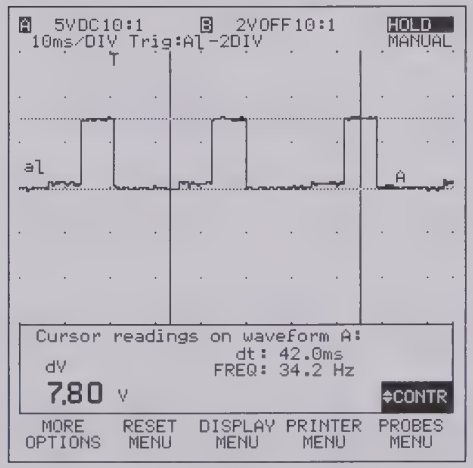
### Selecting Printer Types

The test tool can print directly to an FX/LQ (Epson) type or HP ThinkJet type printer at 1200 or 9600 baud. From the list box, make these printer type selections.

### Selecting Print Options

You can choose from the following print options: Screen, Readings, or Waveforms.

**SCREEN** (default setting) Print a graphic copy of the actual display (Scope, Meter, or in any other mode).




**READINGS** Print a numerical representation of the measured values in table form. Printing can be done once (single) or repetitively with a selected interval time.

```
HOLD FREQUENCY:  980Hz, Vpeak peak: 11.4V, dV: 7.40V, dt: 2.56ms
HOLD FREQUENCY:  980Hz, Vpeak peak: 11.4V, dV: 7.40V, dt: 2.56ms
HOLD FREQUENCY:  980Hz, Vpeak peak: 11.4V, dV: 7.40V, dt: 2.56ms
HOLD FREQUENCY:  980Hz, Vpeak peak: 11.4V, dV: 7.40V, dt: 2.56ms
HOLD FREQUENCY:  980Hz, Vpeak peak: 11.4V, dV: 7.40V, dt: 2.56ms
HOLD FREQUENCY:  980Hz, Vpeak peak: 11.4V, dV: 7.40V, dt: 2.56ms
HOLD FREQUENCY:  980Hz, Vpeak peak: 11.4V, dV: 7.40V, dt: 2.56ms
HOLD FREQUENCY:  980Hz, Vpeak peak: 11.4V, dV: 7.40V, dt: 2.56ms
HOLD FREQUENCY:  980Hz, Vpeak peak: 11.4V, dV: 7.40V, dt: 2.56ms
HOLD FREQUENCY:  980Hz, Vpeak peak: 11.4V, dV: 7.40V, dt: 2.56ms
HOLD FREQUENCY:  980Hz, Vpeak peak: 11.4V, dV: 7.40V, dt: 2.56ms
HOLD FREQUENCY:  980Hz, Vpeak peak: 11.4V, dV: 7.40V, dt: 2.56ms
HOLD FREQUENCY:  980Hz, Vpeak peak: 11.4V, dV: 7.40V, dt: 2.56ms
HOLD FREQUENCY:  980Hz, Vpeak peak: 11.4V, dV: 7.40V, dt: 2.56ms
```

**WAVEFORMS** Print the selected waveform. The waveform is printed in a numerical format that represents sample data points (Scope mode only). You can calculate the real voltage of each data point by subtracting the Y-pos from the data point value (3-0=3, etc), then multiplying this with the 200 mV/dot parameter (3 * 200 mV = 600 mV). The time distance between two dots is 20.0 µs here.

### Printing Grey in White or Black

Print the grey persistence of the display as white or as black on paper.

### Sending to a Printer

Press [START PRINT] to start printing via the serial RS-232-C port. The settings you made in the User Options menu will be used.

```
 ScopeMeter 99 Series II
WAVEFORM Channel A  200mV/dot 20.0us/dot Y-pos 0dot

    3 -128  -78 -128 -128   17   21   23   25   25  -96  -96  -96  -96  -77
  -96  -83  -83  -72  -77  -96  -96  -83  -72  -77
  -96  -96  -83  -73  -77  -96  -96  -83  -73  -73  -96  -96  -83  -71  -74
  -96  -96  -83  -71  -74  -96  -96  -83  -72  -77                       9
  -96  -96  -83  -73  -78  -96  -96  -83  -73  -73 -128  -83  -79  -78  -72
  -96  -96  -83  -72  -77  -96  -96  -83  -73  -71
  -96  -96  -83  -73  -72  -96  -96  -83  -73  -78 -115 -118 -128  -28  -27
  -27  -26  -26  -24  -23  -20  -17  -14  -11   -7

   -4    0    3    6    9   12   14   18   21   23   25   25   26   27   28
   28   25   25   23   22   19   17   12   11    8
    5    1   -2   -7  -10  -11  -15  -17  -20  -23  -24  -26  -26  -28  -27
  -26  -27  -26  -24  -23  -22  -18  -17  -14  -11
   -8   -5    0    3    5    9   12   15   18   21   23   24   26   27   28
   27   27   26   25   23   22   19   17   13   10
    8    4    1   -1   -6   -9  -12  -14  -18  -20  -22  -24  -25  -27  -27
  -28  -27  -27  -26  -25  -24  -22  -20   18  -14

  -11   -8   -5    0    3    6    8   12   14   18   21   22   24   26   27
   27   27   28   27   25   23   22   19   17   15
   11    8    5    1   -3   -5  -10  -13  -14  -18  -20  -23  -25  -25  -27
  -27  -28  -27  -27  -26  -25  -24  -22  -20  -17
  -13  -11   -8   -3    0    3    6   10   13   15   18   20   22   24   26
   27   27   27   28   27   25   23   22   20   17
   14   12    9    5    1   -1   -5   -7  -12  -15  -17  -20  -22  -24  -26
  -26  -28  -28  -27  -28  -25  -24  -23  -22  -20

  -17  -15  -10   -8   -3   -1    3    5    8   12   15   19   20   22   23
   26   28   27   26   27   27   26   24   22   20
   17   13   11    8    5    2   -3   -5   -9  -13  -15  -17  -20  -23  -24
  -26  -26  -27  -28  -27  -28  -27  -24  -24  -21
  -20  -17  -14  -11   -9   -4    0    2    5    9   12   14   17   20   24
   24   25   27   27   27   27   27   26   23   22
   20   16   15   12    9    5    2   -3   -5   -9  -12  -15  -18  -20  -23
  -24  -25  -27  -27  -28  -27  -27  -27  -26  -23

  -23  -20  -17  -13  -11   -8   -3   -2    2    6    9   13   15   18   20
   22   24   27   27   27   27   27   26   25   23
   22   20   17   14   11    8    5    1   -2   -6   -8  -11  -15  -18  -20
  -22  -24  -25  -26  -27  -27  -28  -28  -26  -24
  -24  -22  -19  -18  -14  -11   -8   -5   -1    3    6    8   11   15   17
   20   22   24   26   26   27   27   26   27   26
   25   21   19   16   14   11    8    4    2   -1   -4   -9  -12  -15  -17
  -20  -22  -24  -25  -27  -27  -27  -28  -27  -27

  -25  -24  -23  -20  -17  -14  -12   -8   -5   -1    2    6
```

## USING THE WAVEFORM GENERATOR 91 92 96

Press [SPECIAL FUNCT] and then [F2] to open the GENERATE menu. You can now select a waveform output at the red (GENERATOR OUT) and black (COMmon) 4-mm banana jacks.

```
GENERATOR OUTPUT    : on off
GENERATOR WAVEFORM : square 1.95 kHz
```

*Figure 6-9 Generator Menu*

1. Select GENERATOR OUTPUT and turn the generator on and off.

2. Choose one of the six waveforms:
   - Square wave: 1.95kHz, 976Hz, or 488Hz (all at 5V p-p)
   - Sine wave: 976 Hz (1V p-p)
   - Slow ramp: Voltage (-2V to +2V, 1 mA maximum) Current (0 to 3 mA, 2V maximum)

The generator is automatically disabled in the Ω, ⊣⊢, EXT.mV and COMPTEST mode.

The generator output can also be selected as trigger source; when turned on, it replaces the EXT (external) trigger source in the TRIGGER menu.

## TESTING COMPONENTS 91 92 96

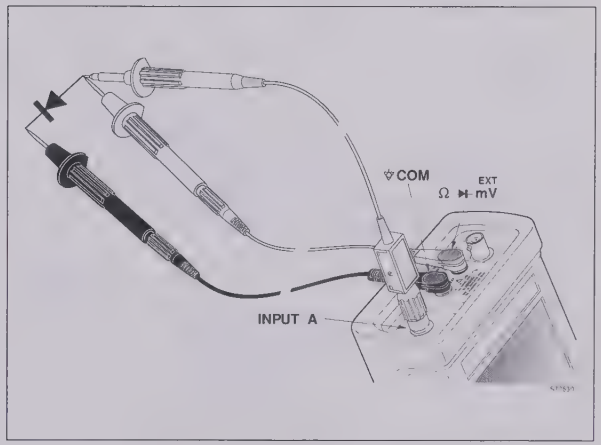



*Figure 6-10 Component Test Setup*

From the Special Functions menu, press [F4] to use the ScopeMeter test tool as a predefined measuring tool for components. This opens the Component Test menu.

1. Select COMPONENT MENU and turn the component test on and off.

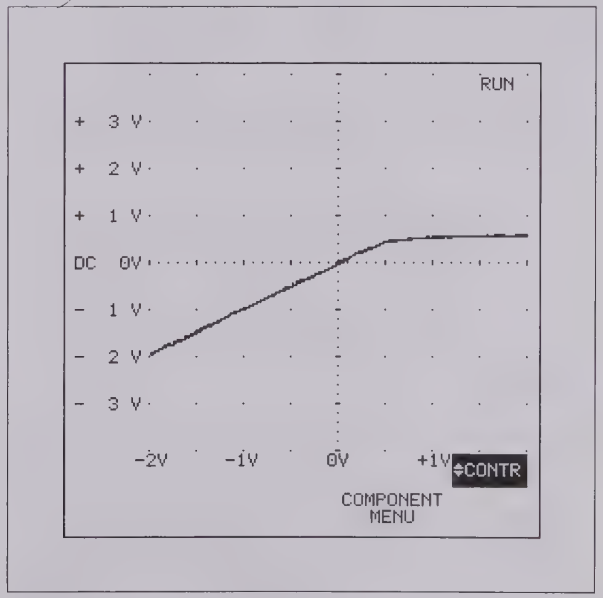
2. Choose the type of WAVEFORM SOURCE: the test tool outputs a slow voltage sweep (-2V to +2V) or current sweep (0 to +3mA).

3. Choose the TEST PROBE COUPLING: AC or DC coupling.

Connect the component to be tested between the red (GENERATOR OUT) and black (COMmon) 4-mm banana jacks. Measure the component on INPUT A. It's characteristics are shown on the special measure display.

Auto Set cannot be used with the Component measurement mode.

The given display shows a diode test with a slow voltage sweep (-2 to +2V).



## CHANGING THE RESET CONFIGURATIONS

When you turn the test tool on, it begins operation in the last-known configuration, and the main SCOPEMETER function menu appears. Subsequent power-ons maintain configuration changes made with keystrokes or through recall of a setup memory during the previous session. Default settings are used at the first power-on or after a reset. You can reset the test tool at any time. The ScopeMeter test tool can be reset in the following way:

- Master Reset (F5 + ON/OFF). A definition of Master Reset is given below.
- Reset F4 + ON/OFF. Same as Master Reset, but does not clear the memories.

### CAUTION

**A Master Reset clears all Screen, Waveform, and Setup memories.**

The Master Reset includes the following settings:

- Meter Mode
- Three Readings for Meter Mode, and two Readings for Scope Mode
- Autoranging
- Backlight Off
- Probe Scaling 10:1
- All Memories Cleared
- Generator Off
- Print Format Screen
- Printer Setup FX/LQ Graph, 1200 Baud

To perform a selective reset, do the following:

1. From the User Options menu, press F2 to open the RESET MENU (see Figure 6-11).

2. Choose the reset options which include: the default settings for Master Reset, or selectively resetting any of the main modes, e.g., Scope, Meter, Ohm, Diode, or EXT.mV.

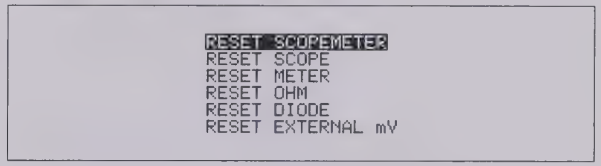



*Figure 6-11 Reset Menu Window*

3. Press F5 to reset.

Some of the configuration settings can be preset to become active at every power on.

1. From the User Options menu, press F1 (MORE OPTIONS), and open the STARTUP MENU window (see Figure 6-12).

*Figure 6-12 Startup Menu Window*

2. Specify on or off for each of the following:
   - whether or not to identify the waveform (trace) source (**TRACE IDENTIFIERS**).
   - whether or not to identify the trigger source, slope, level, and delay (**TRIGGER IDENTIFIER**)
   - whether or not to **CLEAR at RUN**. When Clear at Run is set to on, and you perform a single shot, the old waveform is cleared first each time the test tool writes a new waveform.
   - whether or not to select high or low **HELP LEVEL** facility. When the Help Level is set to high, you will get all on-line information available in your ScopeMeter test tool.

   Factory defaults place all four of these items on.

3. Press [F5] to select the new Default Settings.

4. Press [F1] to close the window.

## ALTERING THE CONTINUOUS AUTO SET CONFIGURATION

When [AUTO SET] is pressed, the instrument assumes the Continuous Auto Set configuration.

There are ways to alter the Continuous Auto Set configuration. These two methods are discussed below.

### Using Manual Override

Pressing [mV RANGE] [RANGE V] disables autoranging for voltage attenuation only. Press [AUTO SET] to resume the normal mode of operation for Continuous Auto Set.

Pressing [s TIME ns] disables autoranging for the time base setting only. Press [AUTO SET] to resume the normal mode of operation for Continuous Auto Set.

Changing any of the trigger settings disables autoranging for voltage, time base, and triggering. Press [AUTO SET] to resume the normal mode of operation for Continuous Auto Set.

### Changing Continuous Auto Set Options

Change the Continuous Auto set configuration as follows:

1. From the User Options menu, press [F1] (MORE OPTIONS) and use △ ▽ to highlight AUTO SET. Press [F5] to open the window (see Figure 6-13).

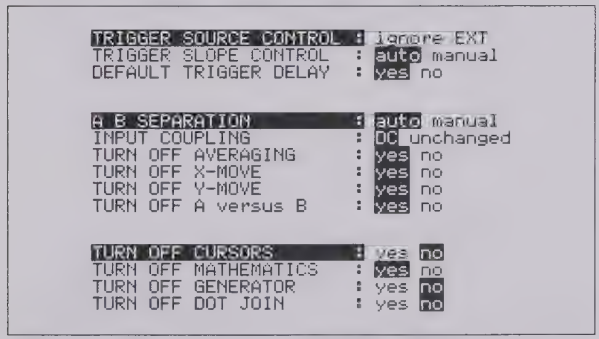

TRIGGER SOURCE CONTROL : ignore EXT
TRIGGER SLOPE CONTROL : auto manual
DEFAULT TRIGGER DELAY : yes no
A B SEPARATION : auto manual
INPUT COUPLING : DC unchanged
TURN OFF AVERAGING : yes no
TURN OFF X-MOVE : yes no
TURN OFF Y-MOVE : yes no
TURN OFF A versus B : yes no
TURN OFF CURSORS : yes no
TURN OFF MATHEMATICS : yes no
TURN OFF GENERATOR : yes no
TURN OFF DOT JOIN : yes no

*Figure 6-13 Continuous Auto Set Window*

The items shown in this window are divided into three pages. Select a page with F3 (PREVIOUS PAGE) or F4 (NEXT PAGE).

2. The first page in the window defines some basic actions taken during Auto Set. Specify whether the Continuous Auto Set will optimize trigger source and trigger slope during measurement. The factory default is "auto". Also specify whether Auto Set will reset trigger delay (default is that any delay set will be turned off).

3. The second page defines the input setup or items that are turned off when the Continuous Auto Set is active.
   **A B SEPARATION** (Default is auto: both waveforms appear, separated by two divisions).
   **A B COUPLING** (Default is DC: both inputs are DC coupled).
   **TURN OFF AVERAGING** (Default is yes: smooth function is turned off).
   **TURN OFF X-MOVE** (Default is yes: waveform in center of the display).
   **TURN OFF Y-MOVE** (Default is yes: waveform in center of the display).
   **TURN OFF A versus B** (Default is yes: A vs B function is turned off).

4. The third page defines functions that are turned off when the Continuous Auto Set is active.
   **TURN OFF CURSORS** (Default is no : Cursors are not turned off).
   **TURN OFF MATHEMATICS** (Default is yes : Mathematic function is turned off).
   **TURN OFF GENERATOR** (Default is no : Generator is not turned off).
   **TURN OFF DOT JOIN** (Default is no : Dot Join remains active).

# Chapter 7
# Measuring Examples


TEMPERATURE MEASUREMENT . . . . . 7-2
CURRENT MEASUREMENT . . . . . 7-4
MEASURING POWER WITH MATH FUNCTION . . . . 7-7
DUAL INPUT THREE-PHASE MEASUREMENT . . . 7-9
PHASE MEASUREMENT USING THE CURSORS . 7-12

This chapter examines some typical measurements that can be made with your ScopeMeter test tool. The examples given can be used as an aid in many applications.

## TEMPERATURE MEASUREMENT

Temperature is an often measured characteristic. The 80T-150U optional Temperature Probe can be used in conjunction with the test tool to measure the surface temperature, air temperature, and non-corrosive liquid temperature. You can measure fluctuations in temperature over a long period of time when the Min Max recording is activated. Readings on the test tool can be given in Fahrenheit or Celsius.

In this example, the air temperature is measured over 24 hours.

Connect the 80T-150U Temperature probe to the red and black 4-mm banana jacks as shown in Figure 7-1.

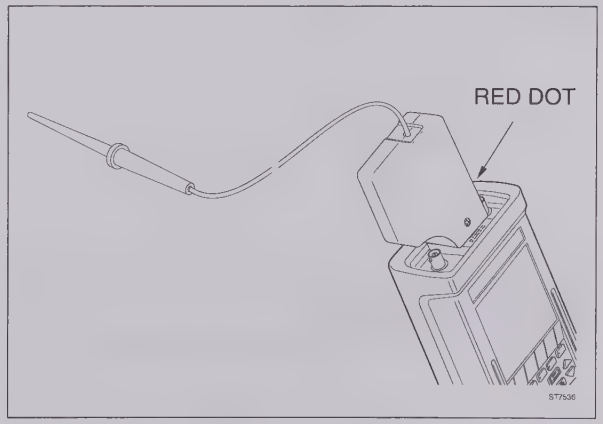



*Figure 7-1 Temperature Measurement Setup*

① F4 + ON/OFF
Do a Reset; probe scaling factor is 10:1.

② F5 (EXT.mV)
Be sure that the slide switch on the probe is in the OFF position. A reading of more than 65 mV DC indicates that the battery of the probe is good.

③ MEASURE MENU ⇨ F1

④ △ ▽: °C PROBE ⇨ F5
Select degrees Celsius range.

⑤ Move the slide switch on the probe to the ˚C position.

⑥ The actual air temperature appears on the display.

⑦ MIN MAX

The test tool starts continuously recording the air temperature and graphs the minimum, maximum, and average temperatures on the display. After about 24 hours the display appears as shown in Figure 7-2.

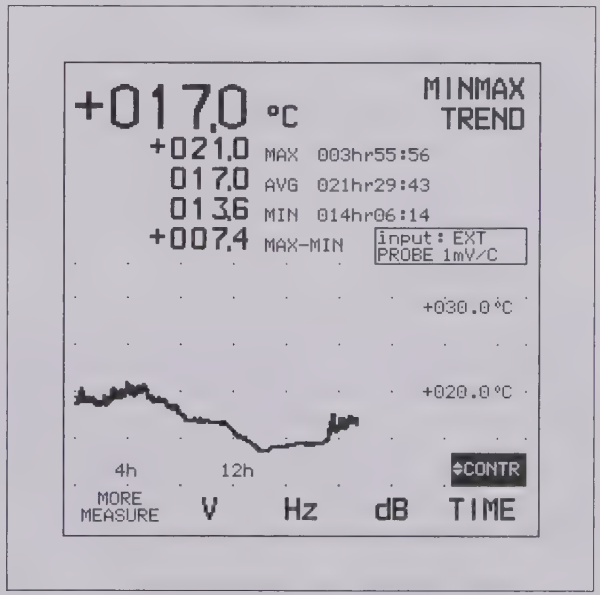



*Figure 7-2 Temperature Measurement with Trend Plot*

## CURRENT MEASUREMENT

The 80i-1000s Current Probe is an optional accessory designed for use with the ScopeMeter test tool to measure current flow in electrical circuits. The reading in the Measure menu can be assigned to current (amps) sensed by the Current Probe. Refer to the instruction sheet provided with the 80i-1000s for complete information about Current Probe operation.

### ⚠ WARNING

**TO AVOID ELECTRICAL SHOCK, USE ONLY CURRENT PROBE ACCESSORIES SPECIFICALLY DESIGNED AND APPROVED FOR USE WITH THE SCOPEMETER TEST TOOL. OTHER PROBES MAY EXPOSE THE OPERATOR TO AN ELECTRIC SHOCK HAZARD IF ANY OF THE THREE COMMON INPUT CONNECTIONS ARE CONNECTED TO A POTENTIAL GREATER THAN 30V RMS OR 42V DC.**

The following example measures the current flow in an electric motor for 220V line power.

Connect the 80i-1000s Current Probe to the red INPUT A BNC as shown in Figure 7-3.

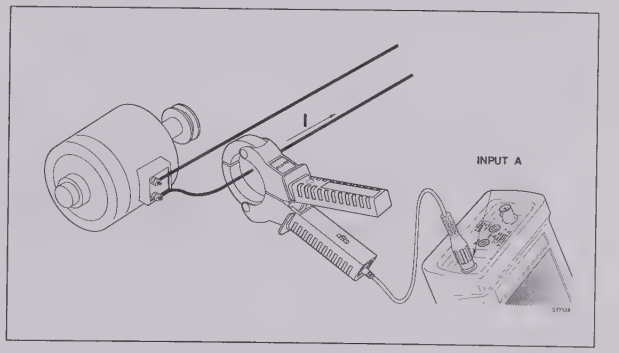



*Figure 7-3 Current Measurement Setup*

① Set current probe range switch to 10 mV/A.

② F4 + ON/OFF
Do a Reset; probe scaling factor is 10:1.

③ MEASURE MENU ⇨ F1

④ F4
Select page 4 of the More Measure window.

⑤ △ ▽ : A AC+DC METER ⇨ F5

⑥ △ ▽ : 10 mV/A ⇨ F5
Select Current Probe range.

⑦ Clamp the Current Probe jaws around the conductor to be measured.

⑧ The actual current appears on the display: 17.43 Arms.

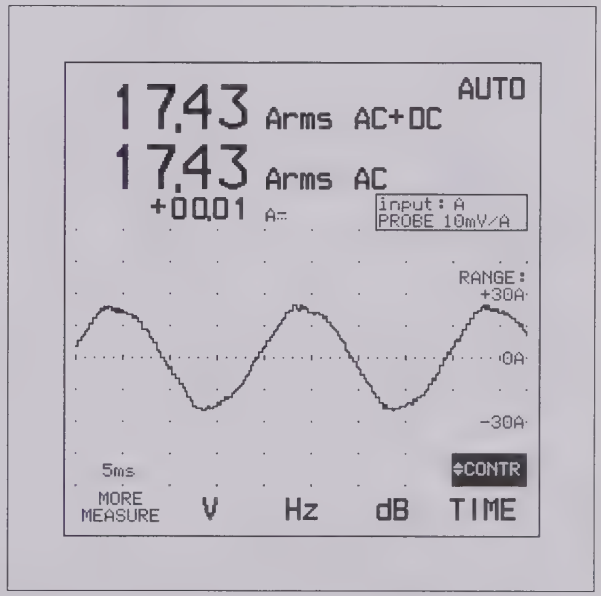



*Figure 7-4 Current Measurement in Meter Mode*

To see the current as a waveform, set the test tool as follows:

① Set Current Probe range switch to 10 mV/A.

② F4 + ON/OFF
Do a Reset; probe scaling factor is 10:1.

③ F1
Select Scope mode.

④ AUTO SET
Select Continuous Auto Set.

⑤ INPUT A ⇨ F5
Select the Probe A menu.

⑥ F5
Open the Probe on INPUT A box.

⑦ △ ▽ :10 mV/A ⇨ F5
Select current range.

⑧ F1
Close the window.

⑨ The test tool displays the current as a waveform, which can be analyzed using all other functions. The selected range appears on the top display.

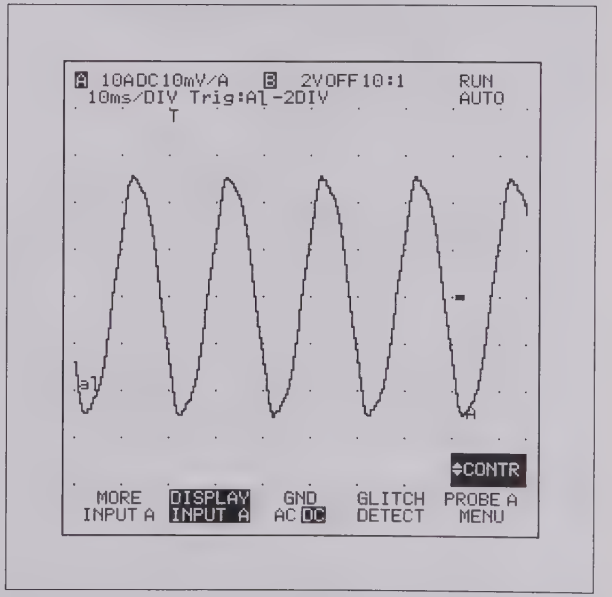



*Figure 7-5 Current Measurement in Scope Mode*

## MEASURING POWER WITH MATH FUNCTION ~~91~~ ~~92~~ ~~96~~

When used with the optional 80i-1000s Current Probe, the ScopeMeter test tool is able to measure voltage and current at the same time. This may be used to measure average power consumption of an electrical load on a single-phase circuit. This measurement is reliable over a wide range of frequencies, irrespective of the wave shapes of voltage or current.

In this example you make use of the previous measurement setup, measuring current with the 80i-1000s on INPUT A, and will add the voltage measurement using the grey 10:1 probe on INPUT B. Be sure that INPUT A is set to 10 mV/A, and INPUT B is set for a 10:1 probe.

This example shows the connection method and MATH function operation that accomplishes this.

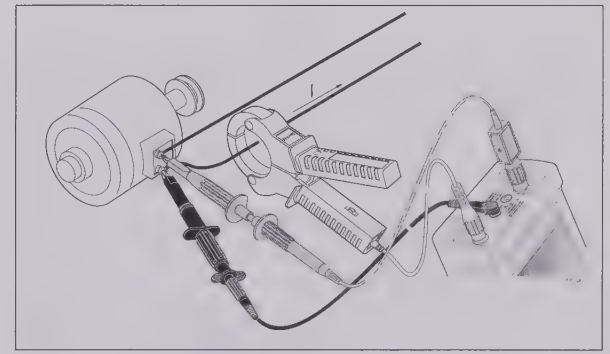


*Figure 7-6 Power Measurement Setup*

① AUTO SET
Select Continuous Auto Set.

② SPECIAL FUNCT

③ F3
Open the Math menu.

```
MATH FUNCTION      : on off
MATH OPERATION     : multiply
SOURCE 1           : A
SOURCE 2           : B
SAVE IN DESTINATION : 1
SCALE RESULT       : /5
```

④ ⇧ ⇩ ⇨ F5
Select each item.
Store the resulting waveform in Destination memory 1.

⑤ F1
Close the window.

In Figure 7-7, INPUT A represents the current measurement, INPUT B the voltage measurement, and Destination memory 1 the product (equals power).

In this example the following scales are used:
INPUT A: 20 A/DIV
INPUT B: 200 V/DIV
Memory 1: 4 kW/DIV

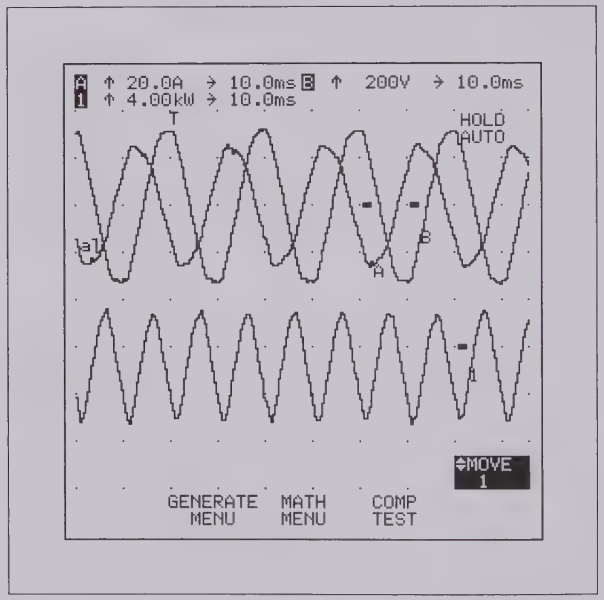



*Figure 7-7 Power measurement*

Shift the resulting waveform over the display as follows:

⑤ ⇕

⑥ ⇧ ⇩ : move 1 ⇨ F5

⑦ ⇧ ⇩ Move the resulting waveform.

## DUAL INPUT THREE-PHASE MEASUREMENT

Dual input measurements can be used for many applications. This example shows how to use these measurements to determine phase rotation of a "Y" connected three-phase system at a load center. Use alligator clips to connect the ScopeMeter test tool to the three-phase system connections.

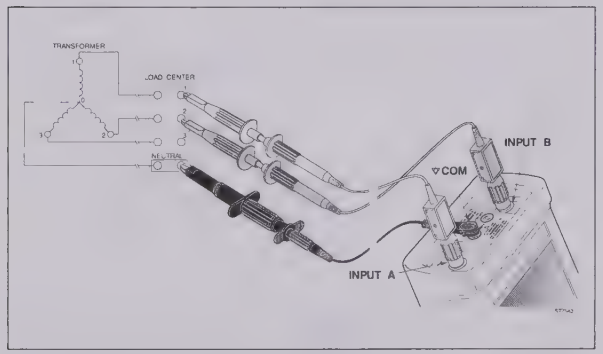



*Figure 7-8 Testing a Three-Phase System*

### WARNING

**THE SETUP REQUIRES CONNECTING TEST LEADS TO LIVE COMPONENTS OF A HIGH ENERGY CIRCUIT. TO AVOID ELECTRIC SHOCK AND/OR EQUIPMENT DAMAGE, USE CAUTION WHEN CONNECTING ALLIGATOR CLIPS TO LIVE COMPONENTS.**

**THE METAL JAWS OF ALLIGATOR CLIPS CAN CREATE A SHORT CIRCUIT BETWEEN CLOSELY SPACED LIVE PARTS. AVOID MAKING CONNECTIONS TO FEEDER CONDUCTORS OR BUS BARS AT ELEVATED POTENTIALS. WHENEVER POSSIBLE, MAKE CONNECTIONS TO THE OUTPUT SIDE OF A CIRCUIT BREAKER WHICH CAN PROVIDE BETTER SHORT CIRCUIT PROTECTION.**

**MAKE CONNECTIONS TO CIRCUIT BREAKERS BY FIRST TURNING THE CIRCUIT BREAKER OFF. THEN CONNECT THE ALLIGATOR CLIP TO THE BREAKER OUTPUT TERMINAL VIA A SHORT PIECE OF INSULATED WIRE AS SHOWN IN FIGURE 7-9.**

Make sure the circuit breaker is turned off. Connect the test tool to two circuit breakers of two different phases and the neutral bus bar as shown in Figure 7-9. Use the alligator clips for the red and grey 10:1 probes and black multimeter test lead.

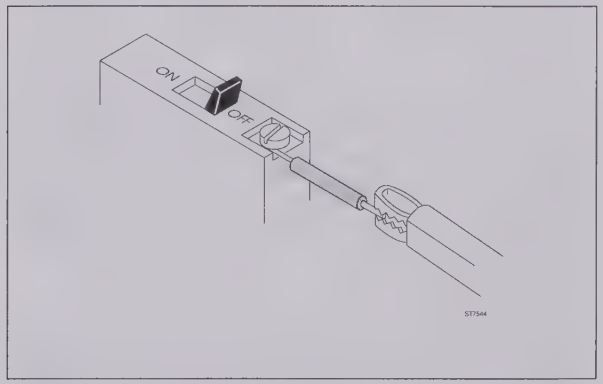



*Figure 7-9 Connecting the Wires*

① F4 + ON/OFF
Do a Reset; probe scaling factor is 10:1.

② F1*
Set the test tool to Scope mode.

③ AUTO SET
Select Continuous Auto Set.

④ Turn circuit breaker on.

⑤ Measure connection 1 and connection 2 (see Figure 7-10.)

The upper display in Figure 7-10 shows that phase 2 (INPUT B) follows phase 1 (INPUT A). The lower display shows that phase 3 follows phase 1.

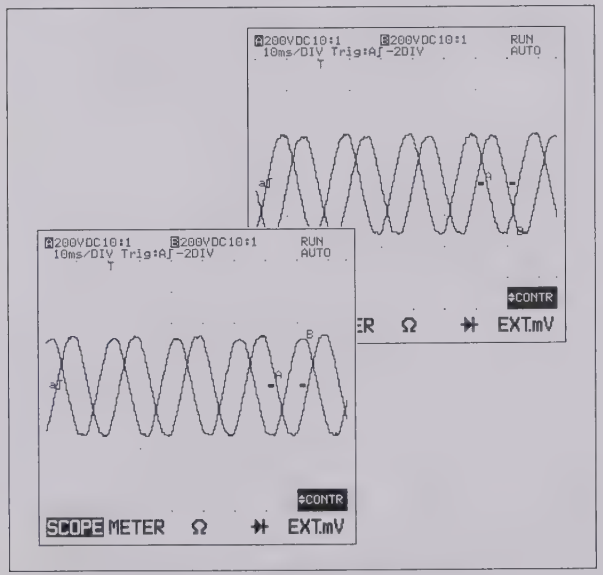



*Figure 7-10 Phase Measurements*

⑥ MEASURE MENU ➪ F2

⑦ △ ▽ : Vrms AC (METER) ➪ F5

The Volt RMS readout (about 230 Vrms) appears on the display. (see Figure 7-11.)

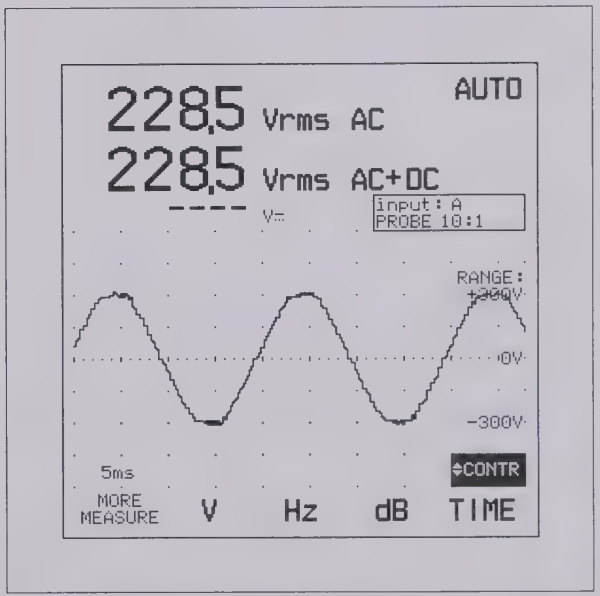



*Figure 7-11 AC Volt RMS Measurement*

## PHASE MEASUREMENT USING THE CURSORS ~~91~~ ~~92~~

In this example you will use the cursors to measure the phase difference between the waveforms on INPUT A and B. Use the two waveforms from the dual input three-phase measurement in the previous exercise. Cursors allow you to make accurate digital measurements. It is advised that you first press [HOLD RUN] to freeze the waveforms to be measured.

① Measure the two sine wave waveforms as explained in the previous example.

② [SCOPE METER]
Return to the main menu.

③ [F1]
Set the test tool to Scope mode.

④ [HOLD RUN]
Freeze the display; **HOLD** appears in the upper right display.

⑤ [SUB MENU] ➪ [F5]
Activate the Cursor readings.

⑥ [F1] ➪ [F4]
Go to page 2 within the More Scope window.

⑦ ▽
Choose MAIN READING.

⑧ [F5]
Open the list box.

⑨ ▽ : PHASE A->B ➪ [F5].

⑩ [F1]
Close the window.

⑪ [◁ LEFT CURSOR ▷] [◁ RIGHT CURSOR ▷]
Position the two cursors on the waveforms; see Figure 7-12.

The display shows the phase between the waveforms on INPUT A and INPUT B: "PHASE A>B -120°" (see Figure 7-12).

To identify the point on the waveforms where the measurement has occurred, you can use the markers on page 3 within the More Scope window.

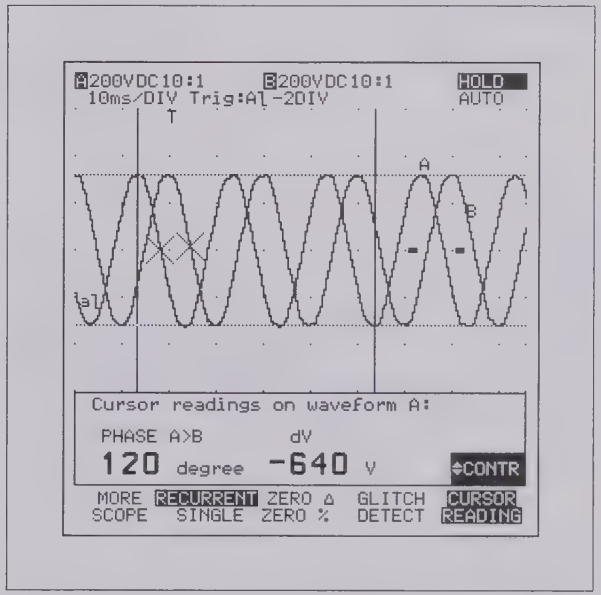



*Figure 7-12 Phase Measurement (with Markers)*

# Chapter 8
# ScopeMeter Test Tool Tutorial


TESTING POTENTIOMETERS . . . . . 8-4
MAKING LOW FREQUENCY VOLTAGE MEASUREMENTS WITH THE METER . . . . . 8-5
ASSISTING CONTINUOUS AUTO SET ON COMPLEX WAVEFORMS . . . . . 8-10
MAKING LOW FREQUENCY MEASUREMENTS WITH THE SCOPE . . . . . 8-17
MAKING SINGLE SHOT MEASUREMENTS WITH THE SCOPE . . . . . 8-20
FINDING HIDDEN WAVEFORM DETAILS WITH THE SCOPE . . . . . 8-22
MAKING SCOPE CURSOR MEASUREMENTS . . . 8-26
USING THE MATH FUNCTIONS . . . . . 8-32

This chapter demonstrates how to use several of the advanced features of your ScopeMeter test tool. To become familiar with these features, you must use the Demonstration Board. All the following tutorials (except "Testing Potentiometers") require that you connect the test tool to the relevant test points (TP1 through TP5) on the "Demo Board". In "Testing potentiometers" you must supply your own potentiometer.
Before making any measurement, be aware of the safety precautions on page VI. The Demo Board connections are shown in Figure 8-1.

*NOTE*

*All displays shown in the example figures are typical values. Actual measured values may vary because the Demo Board signal levels are dependent on the battery voltage.*

**⚠ WARNING**

**TO AVOID ELECTRIC SHOCK OR FIRE:**

- **USE ONLY THE TEST LEAD/PROBE SET SUPPLIED WITH THE SCOPEMETER TEST TOOL (OR SAFETY-DESIGNED EQUIVALENTS) WITHOUT EXPOSED METAL CONNECTORS.**
- **USE ONLY ONE COM (COMMON) CONNECTION.**
- **REMOVE ALL PROBES AND TEST LEADS THAT ARE NOT IN USE.**

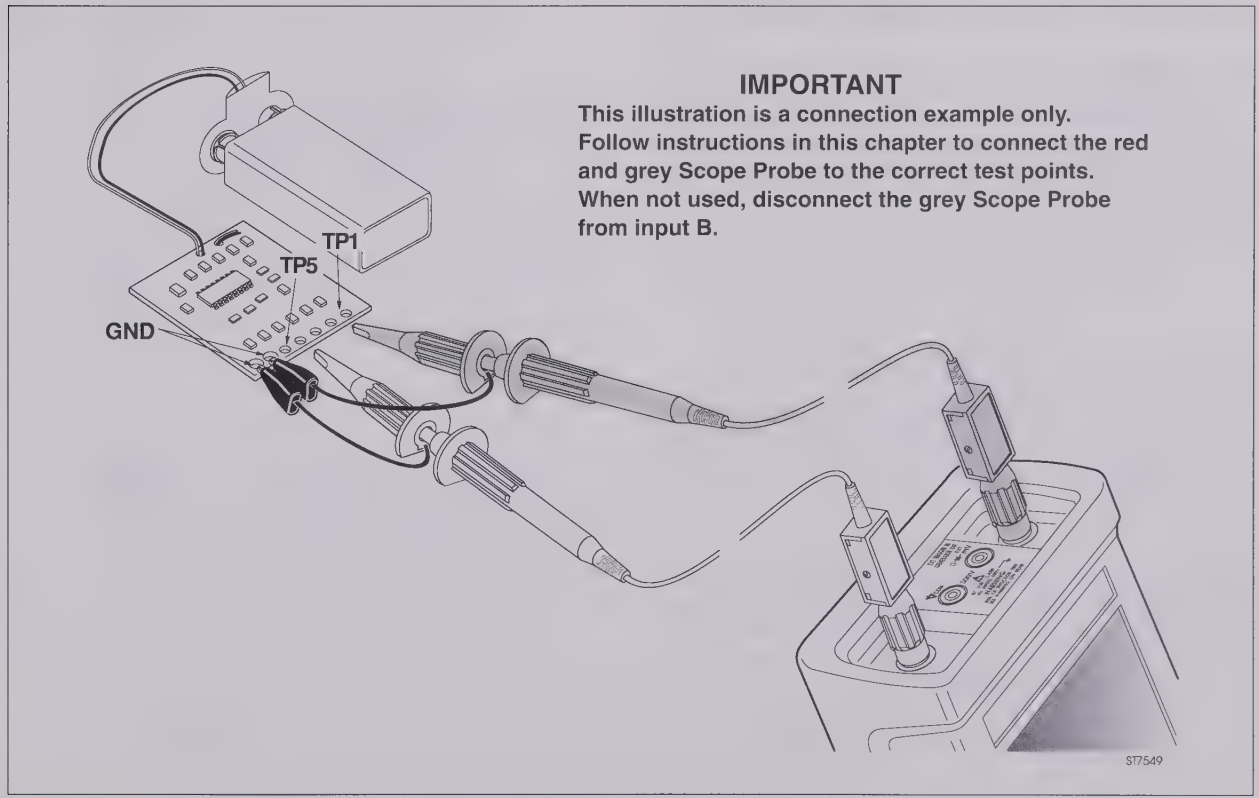

IMPORTANT
This illustration is a connection example only.
Follow instructions in this chapter to connect the red and grey Scope Probe to the correct test points.
When not used, disconnect the grey Scope Probe from input B.
TP1
TP5
GND
ST7549

*Figure 8-1 Tutorial Setup*

## TESTING POTENTIOMETERS

The ScopeMeter test tool can provide a numeric readout and a graphic display of resistance. Using the COM (black) and Ω (red) 4-mm banana inputs, connect the test tool to the wiper and one end of the variable resistance to be tested. Use the multiméter test lead set to connect. This signal is not available on the Demo Board.

To select the ohms mode:

1. Reset the ScopeMeter test tool (F4 + ON/OFF).
2. Press F3 to select the Ω mode.

A message appears, indicating that the banana jacks are used as inputs now. After closing this message, the display should be similar to Figure 8-2, but the value will depend on the potentiometer that is used.

Once the reading is stable, vary the resistance (adjust the potentiometer) and observe the movement on the waveform display underneath the reading. Spikes on the display indicate discontinuities in the potentiometer. The resistance trace display enables quick testing of potentiometers and shows discontinuities immediately.

Remove the variable resistor from the banana jacks.

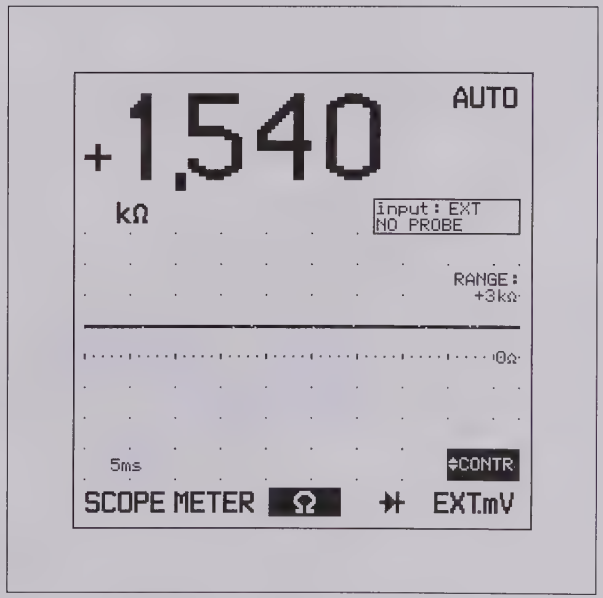



*Figure 8-2 Testing Potentiometers*

## MAKING LOW FREQUENCY VOLTAGE MEASUREMENTS WITH THE METER

The ScopeMeter test tool can make RMS voltage measurements on signals as low as 1 Hz. In this example, you will practice making such a measurement.

### Connection

Connect the red scope probe from INPUT A (meter high) to TP1 (the test signal) on the Demo Board. Connect the meter low to ground of the Demo Board using either the COM banana input with a test lead or the ground lead of the probe hook clip. Remove all other connections.

### Making the Measurement

1. Reset the ScopeMeter test tool (F4 + ON/OFF).

You should now see two unstable voltage readings, an invalid Hz reading, and the waveform display. Also you occasionally hear the ranging relays click. The autoranging is the result of a low frequency signal being produced at TP1. This can be examined by finding the minimum and maximum levels of the signal. See following example.

**A. FINDING THE MINIMUM AND MAXIMUM.**

The Minimum and Maximum levels in this example are DC.

To select DC Volts as the main reading:

2. Press MEASURE MENU.

3. Press F2 (V).

4. Press F5 to select the highlighted function V DC METER.

The first reading shows the "V DC" reading. Notice the numerical readout is unstable and the waveform display shows a changing level, sometimes high, or low, or with a vertical edge, and the ranging relays are still slowly clicking. (See Figure 8-3.)

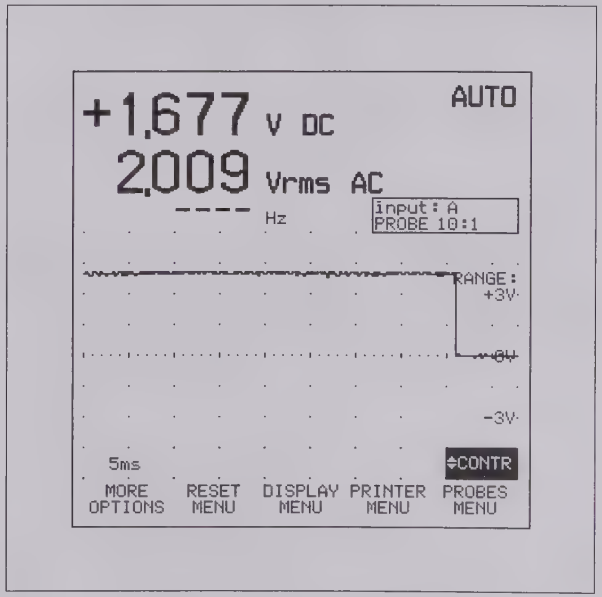



*Figure 8-3 Unstable V DC Display*

Selecting a manual range will stop the relay clicking:

5. Press [RANGE V] [mV RANGE] of INPUT A, and select the 10V range. The range appears on the right of the trace display.

The display now shows a DC reading between 0 and about 4 volts, and the trace display shows changing levels and sometimes an edge.

Now select the Min Max recording mode:

6. Press [MIN MAX].

The test tool beeps each time a new minimum or maximum is measured. After a couple of minutes you should see a readout similar to Figure 8-4. Note the time stamp which indicates the elapsed time before the displayed minimum or maximum occurred. The Average value time stamp shows the total elapsed time since [MIN MAX] was pressed. At the same time the lower part of the display shows the trend plot of the waveform.

To turn off the Min Max recording mode:

7. Press [MIN MAX].

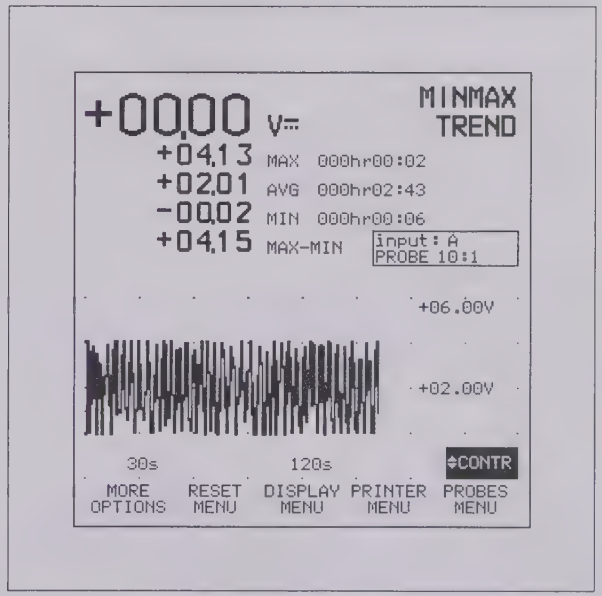



*Figure 8-4 MIN MAX Recording with Trend Plot Function*

### B. STABILIZING THE TRACE DISPLAY

On the left bottom of the waveform display you see a readout of "5 ms", which is the horizontal time base of the trace. The 5 ms/DIV is the slowest time base used in the autorange mode and gives measurements down to 15 Hz. To manually select a slower time base:

8. Press [s TIME].

Continue pressing the [s TIME] key until the time base readout is 100 ms. The digital display should now be stable and show a reading of about 2 volts. The waveform display is also stable. To increase the waveform amplitude, select the 3V range:

9. Press [mV RANGE] of INPUT A to select the 3V range.

The ScopeMeter test tool has a DC overrange capability to 4500 counts, which is 4.5V for the 3V range; therefore, you will see the 4V high level of this signal even though the 3V range has been selected as shown in Figure 8-5.

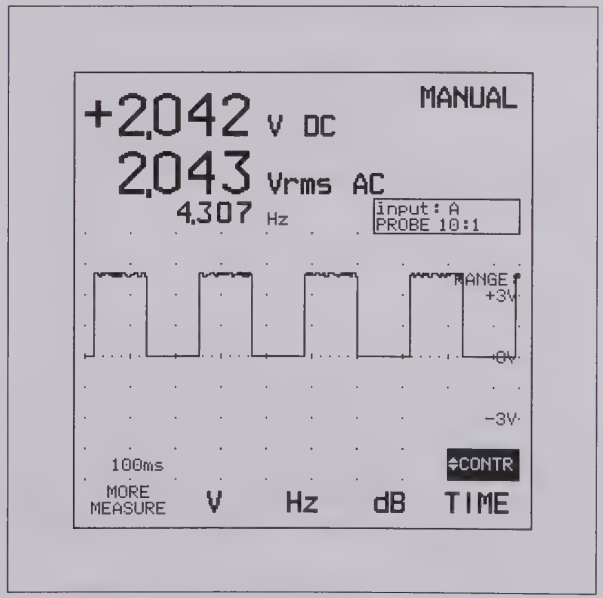



*Figure 8-5 Displaying DC Overranging*

### C. MAKING AN AC-COUPLED MEASUREMENT

To select an AC-coupled measurement:

10. Press [SCOPE METER].
11. Press [SUB MENU] to open the Meter mode Submenu.
12. Press [F1] [MORE METER].
13. Use ▽ to highlight ADD MAIN READING, and press [F5] to open the list box.
14. Use ▽ to highlight Vrms AC (no DC), and press [F5] to select.
15. Press [F1] to close the window.

Comparing the AC trace of Figure 8-6 with the DC trace of Figure 8-5, you see that the waveform is now centered vertically about the middle of the screen and slopes between the switching edges. The slopes appear because the waveform is AC coupled where higher frequency waveforms (>50 Hz without probe or >5 Hz with a 10:1 probe) can be measured accurately.

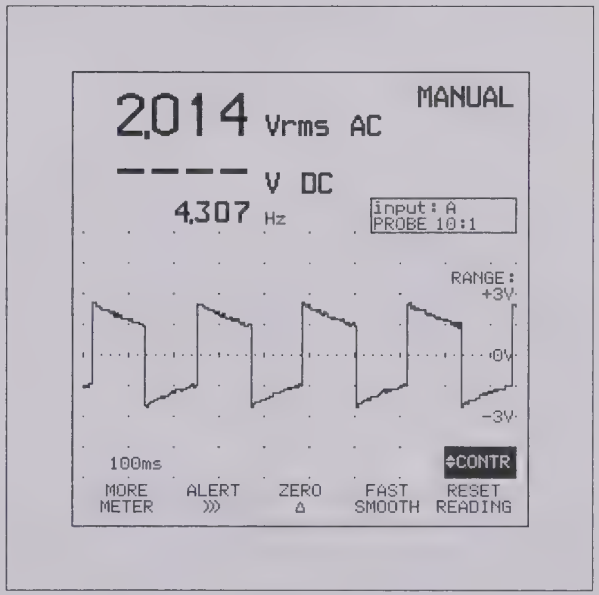



*Figure 8-6 Vrms AC Display in Meter Mode*

To make the true RMS voltage measurement on this low frequency signal, measure Vrms AC+DC in the Measure Menu:

16. Press [MEASURE MENU].

17. Press [F2] (V).

18. Use ▽ to highlight Vrms AC+DC METER, and press [F5] to select.

19. Press [s TIME] four times to slow the time base to 100 ms/DIV.

The waveform now looks like the DC measurement and a true Vrms AC+DC measurement is made.

**Tip:**
In some cases AC coupled measurements give one more digit of resolution over Vrms AC (DC coupled). When making low frequency AC measurements with the test tool, be sure to select Vrms AC (no DC) in the Meter mode, and ensure the waveform display is stable. If it is not, manually reduce the time base. Then you can be sure to make reliable measurements.

## ASSISTING CONTINUOUS AUTO SET ON COMPLEX WAVEFORMS

In the Scope mode, Auto Set samples the inputs to see which have signals connected, scales the waveform(s) to fit on the screen, scales the time base to show a number of cycles of the waveform, and sets the trigger level to the best position on the waveform.

Continuous Auto Set gives a stable display of most of the repetitive waveforms, with some exceptions, which can be split into three types.

- Complex Waveforms, such as modulated signals.

- Slow repetitive signals under 15 Hz. (See "Making Low Frequency Measurements With the Scope" further on in this Chapter.)

- Single Shot signals. (See "Making Single Shot Measurements With the Scope" further on in this Chapter.)

The following example covers the first of these unusual signal areas.

### Connection

Connect the red scope probe from INPUT A to TP3 on the Demo Board.

### Making the Measurement

1. Reset the ScopeMeter test tool (F4 + ON/OFF).
2. Press F1 to select the SCOPE mode.
3. Press AUTO SET.

The waveform appears to have a number of levels. Adjust the time base and amplitude to give a display as shown in Figure 8-7:

4. Use MOVE to move the ground level to the third division from the bottom. The ground icon (▬) on the right side of the display identifies the ground level.
5. Press mV RANGE to increase amplitude if required.
6. Press s TIME ns to set the time base to 10 ms/DIV if required.

The waveform in Figure 8-7 has five distinct levels. The trigger level chosen by Auto Set is the best position of the waveform. Because this waveform has pulses on different levels, triggering occurs on the largest pulse. This results in a stable display. The waveform can now be clearly seen as a repetitive block of four different pulses.

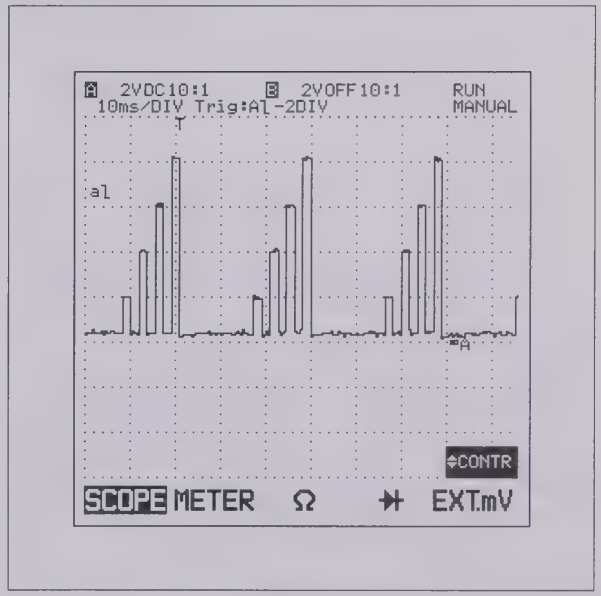



*Figure 8-7 Stable Scope Display*

To see the block of four pulses in detail, increase the time base and use pretrigger delay:

7. Press TIME ns to increase the time base to 2ms/DIV.
8. Press ▲▼.
9. Use △ ▽ to highlight "time delay", and press F5 to select.
10. Use ▽ to adjust the time delay to -7 divisions (refer to Figure 8-8).

Adjusting the time delay to -7 divisions has moved the trigger point to the seventh division on the display, and you now see seven divisions of information that occur before the trigger. (See Figure 8-8.) You can use Zoom to look at the falling edge detail of the 50% pulse. The Zoom function expands the trace referenced to the fourth time division and automatically adjusts the delay.

11. Press ▲▼.
12. Use △ ▽ to highlight "scope zoom", and press F5 to select.
13. Use △ to zoom in the waveform.

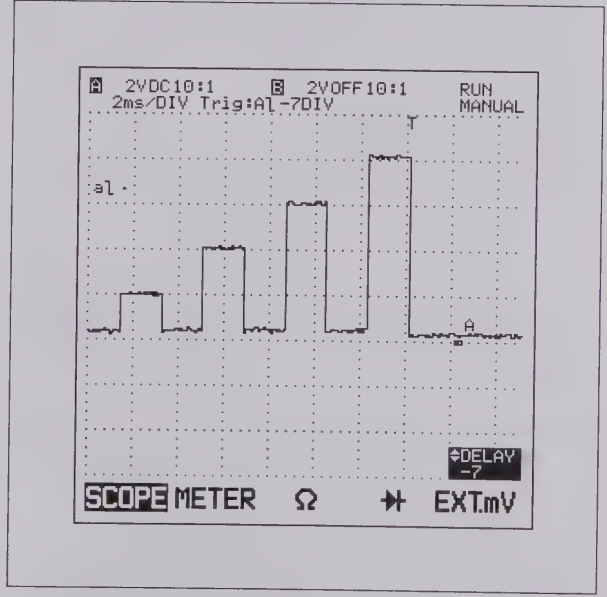



*Figure 8-8 Time Delay -7 Divisions*

**Tips and Techniques for a stable display:**

If there is no highest pulse, there are two other techniques to trigger on a waveform. These are:

- Using N-CYCLE delay.
- Using a stable trigger source on another input.

**(I) Using N-CYCLE delay for waveforms with a repetitive pattern.**

Many waveforms are built from a repetitive pattern or sequence of events. For example, a four-cylinder car has four steps in its sequence, or a variable frequency motor drive has a fixed number of pulses but varies the frequency and repetition rate. The waveform on TP3 has four pulses in its sequence of varying amplitude. To simulate the non-triggerable waveform, adjust the trigger level to a lower level.

1. Press [AUTO SET].
2. Press [▲▼].
3. Press ▲ ▼ to highlight the "trigger level", and press [F5] to select.
4. Use ▼ to adjust the trigger level to about 1.00V (see Figure 8-9).

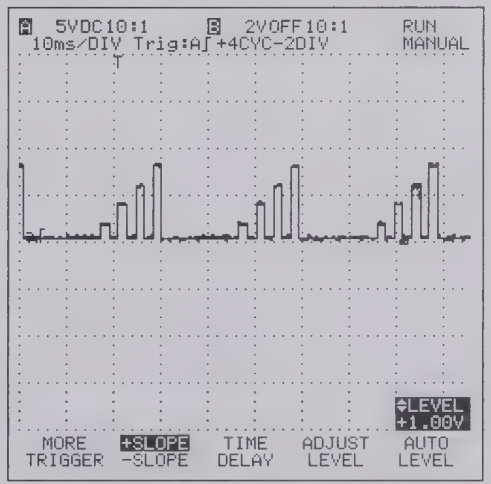



*Figure 8-9 Triggering on N-CYCLE*

To use the N-Cycle mode, do the following:

5. Press [TRIGGER].
6. Press [F1] to open the MORE TRIGGER window.
7. Press [F4] for page 2.
8. Use ▽ to highlight TRIGGER SPECIAL DELAY.
9. Press [F5] to open the list box.
10. Use ▽ to highlight NCYCLE, and press [F5] to open the NCYCLE DELAY box.
11. Use △ ▽ to set N-CYCLE to 4 cycles.
12. Press [F1] (CLOSE) to activate.
13. Press [F1] to close the window.

The N-CYCLE sequence has a random starting position within the sequence of events. As the N-CYCLE counts trigger pulses, it always provides a trigger output after the nth occurrence (4th in this example, see Figure 8-9). In this way it remains synchronized so the waveform triggering always occurs on the same nth pulse in the sequence. In the N-CYCLE mode, triggering is possible only on INPUT A.

**(II) Find a stable trigger source that can be connected to the other input.** ~~91~~

In many applications it is possible to find another waveform that can serve as a trigger source, then Continuous Auto Set does all the work for you. To try this connect the red scope probe from INPUT A to TP3 and connect the grey scope probe from INPUT B to TP2.

1. Reset the ScopeMeter test tool ([F4] + [ON OFF]).
2. Press [F1] to select the SCOPE mode.
3. Press [AUTO SET].
4. Press [RANGE V] [mV RANGE] on INPUT A and INPUT B to adjust the amplitudes if required.
5. Use [MOVE ▽] [△ MOVE] on INPUT B to position the B waveform at the bottom of the display (see Figure 8-10).

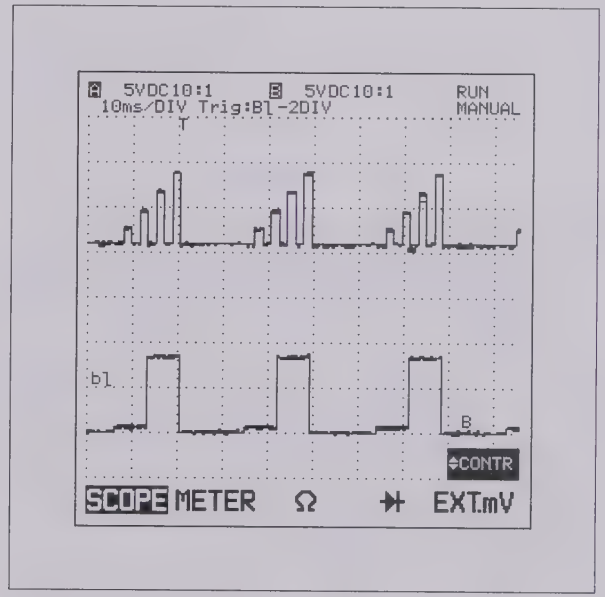



*Figure 8-10 Stable Triggering on INPUT B*

INPUT B is automatically detected during the Auto Set and since it has a lower frequency than INPUT A, it is chosen as the trigger signal. This technique can be used for PWM (Pulse Width Modulated) motor drives where the power line signal can be used (see Figure 8-11).

**⚠ WARNING**

**MEASURING ON PWM MOTOR DRIVES CAN CREATE A POTENTIAL SHOCK HAZARD.**

- **ENSURE THAT THE MOTOR IS OFF BEFORE YOU CONNECT OR DISCONNECT PROBES OR TEST LEADS.**
- **USE ONLY INSULATED PROBES, TEST LEADS, AND CONNECTORS SPECIFIED IN THIS MANUAL WHEN MAKING MEASUREMENTS >42V PEAK (30V RMS) ABOVE EARTH GROUND OR IN CIRCUITS >4800 VA.**
- **USE PROBES AND TEST LEADS WITHIN RATINGS AND INSPECT BEFORE USE.**

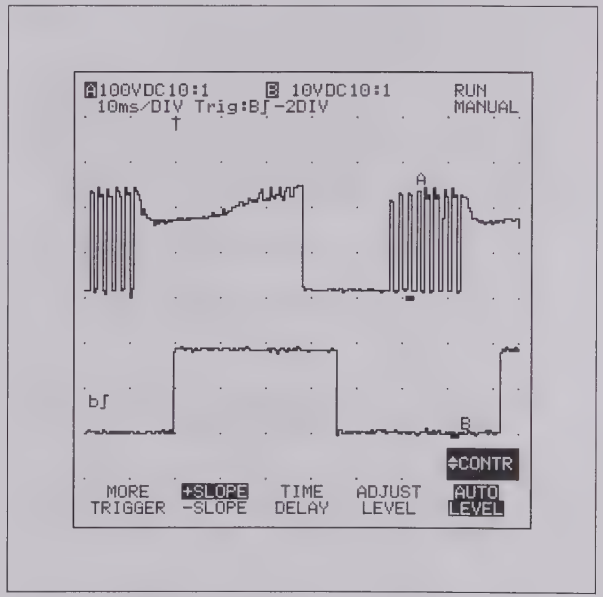



*Figure 8-11 PWM Motor Drive Signals*

## MAKING LOW FREQUENCY MEASUREMENTS WITH THE SCOPE

### Connection

Connect the red scope probe from INPUT A to TP4 on the Demo Board. Remove the grey Scope probe.

### Making the Measurement

1. Reset the ScopeMeter test tool (F4 + ON/OFF).
2. Press F1 to select the SCOPE mode.
3. Press AUTO SET.

To find the waveform, do the following:

4. Press INPUT A.
5. Use F3 to select AC coupling (indicated on the top left of the display).

This technique was used to display the waveform around the ground level. The ground icon (▬) on the right side of the display identifies the ground level.

Look at the display and notice that the waveform occassionally makes larger changes in level. The Continuous Auto Set tries to find the best trigger level. To trigger on low frequency waveforms, you have to set the trigger level manually.

6. Press ◆.
7. Use ▽ to higlight "trigger level", and press F5 to select.
8. Use △ ▽ to adjust the trigger level to one division above ground "▬" level.

The ScopeMeter test tool is in the Free Run mode, which updates the display if a trigger is not found within 100 ms of starting the acquisition. For slow waveforms, Free Run must be off to prevent false triggering. To accomplish this:

9. Press TRIGGER.
10. Press F1 to open the MORE TRIGGER menu.
11. Use ▽ to highlight TRACE START, and press F5 to open the list box.
12. Use ▽ to highlight "wait for trigger", and press F5 to select.
13. Press F1 to close the window.

Most of the time the displayed waveform remains still and the status NOTRIG appears in the top right display. This status message changes to RUN when the large level occurs and indicates that triggering has taken place. Adapt the range and the time base to see the waveform.

14. Use [s TIME] to slow the time base to 500 ms/DIV.

15. Use [RANGE V] [mV RANGE] to set the range to 2 V/DIV.

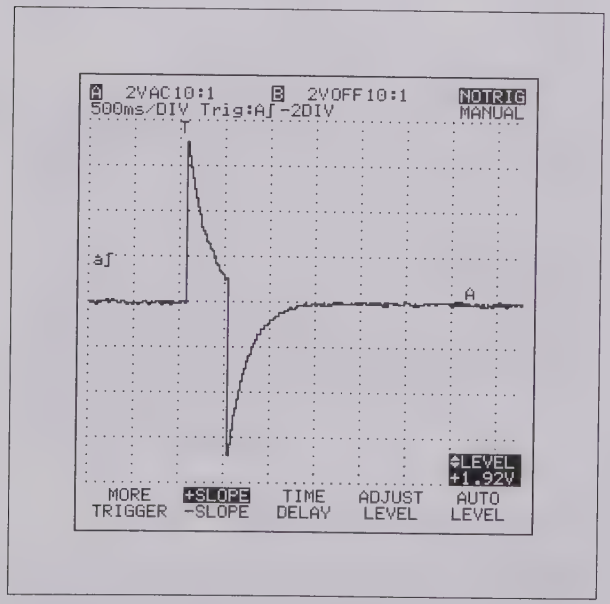



*Figure 8-12 Trigger on AC Coupling*

The slope of the waveform between the switching edges indicates that it was set for AC coupling. But accurate low frequency measurements require DC coupling. To choose DC coupling again, do the following:

16. Press [INPUT A].

17. Use [F3] to select DC coupling (indicated on the top left of the display).

There should be two correctly formed pulses on the display. Reduce the time base further to see the complete waveform.

18. Use [s TIME] to slow the time base to 1sec/DIV.

The waveform is a 0.5s pulse that occurs every 4 seconds. (See Figure 8-13.)

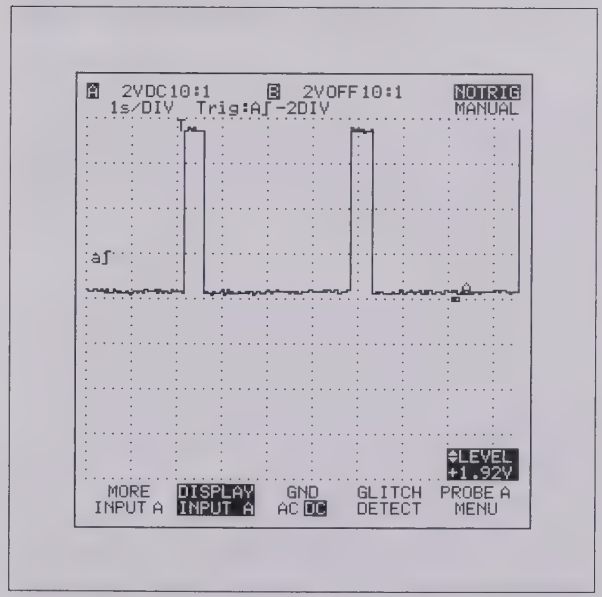



*Figure 8-13 Trigger on DC Coupling*

**Tips for low frequency measurements:**

**(I) Always choose DC coupling for low frequency measurements.**

**(II) Make sure FREE RUN is off, or the display will possibly be unstable.**

**(III) If you are in doubt about the nature of a waveform, use the following "quick indication" method.**

Connect INPUT A only.

1. Reset the ScopeMeter test tool ([F4] + [ON OFF]).
2. Press [F1] to select the SCOPE mode.
3. Press [AUTO SET].
4. Press [SUB MENU].
5. Press [F4] turn GLITCH DETECT on.
6. Press [s TIME] to slow the time base.

Continue to slowly reduce the time base until you can see enough detail of the waveform to make the best amplitude, time base, and trigger settings. When you select a time base of 2 sec/DIV or slower, the Roll mode is activated. The Roll Mode functions like a pen recorder. Try this on TP4.

## MAKING SINGLE SHOT MEASUREMENTS WITH THE SCOPE

A Single Shot measurement captures and freezes a one-time waveform occurrence. Although the Demo Board does not provide a Single Shot output, it is possible to practice this technique on a low repetition rate waveform.

### Connection

Connect the red scope probe from INPUT A to TP4 on the Demo Board.

### Making the Measurement

Repeat the previous application "MAKING LOW FREQUENCY MEASUREMENTS WITH THE SCOPE", and continue from point 18 with the display as shown in Figure 8-13. You will make Single Shot measurements to examine the rising and falling edges of a pulse. To make a Single Shot measurement, you must ensure the correct trigger level is set, and to see more detail you need to increase the time base.

1. Press [TRIGGER] to open the trigger menu.
2. Press [F2] to select +SLOPE.
3. Use ▲ ▼ to adjust the trigger level to the mid level of the waveform.
4. Press [TIME ns] a number of times to increase speed to 10 µs/DIV.

Next adjust the time delay so that the slope will be at the center of the display.

5. Press [◆].
6. Use ▲ ▼ to highlight "time delay", and press [F5] to select.
7. Use ▼ to adjust the time delay to -4 divisions.
8. Press [SUB MENU].
9. Press [F2] to highlight SINGLE.

You have now prepared everything for a Single Shot, including positioning the trigger point at about the center of the display. A "T" on top of the display indicates the trigger point.

To start the Single Shot measurement:

10. Press [HOLD RUN]

The display is first cleared, the rising edge of the pulse is now captured, and the ScopeMeter test tool has returned to the HOLD mode (see Figure 8-14). To capture the falling edge of the pulse in the Single Shot mode:

11. Press [TRIGGER].

12. Press [F2] to select the - SLOPE.

13. Press [HOLD RUN] to start the Single Shot.

You can now see the difference in the speed of the rising and falling edges of this waveform. Note that in the Startup menu window you can configure the ScopeMeter test tool to clear the display each time a new Single Shot is started. To find the Startup menu from the More User Options window, first press [USER OPTIONS], and then [F1].

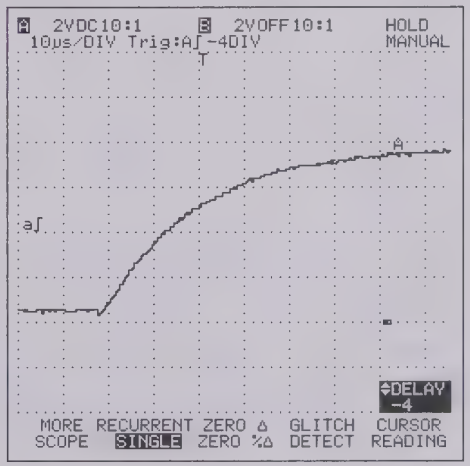



*Figure 8-14 Single Shot Measurement*

**Tips for single shot measurements:**

**(I) Make sure DC coupling is on for the input being used.**

**(II) Make sure that TRACE START is set for "Wait for Trigger".**

**(III) Set a trigger level that is above the base line noise but below the expected waveform amplitude.**

**(IV) Use TIME delay to ensure that you catch the start of the event, for example -4 divisions.**

**(V) Select a time base that is fast enough to catch the waveform, yet slow enough to capture a sufficient length of waveform. Often the use of the GLITCH DETECT mode (see the following example), and the CAPTURE 20 DIV mode can help.**

## FINDING HIDDEN WAVEFORM DETAILS WITH THE SCOPE

### A. GLITCHES

#### Connection

Connect the red scope probe from INPUT A to TP2 on the Demo Board.

#### Making the Measurement

1. Reset the ScopeMeter test tool ([F4] + [ON OFF]).
2. Press [F1] to select the SCOPE mode.
3. Press [AUTO SET].

It appears as if the waveform is a simple pulse with about a 25% duty cycle. Occasionally small spikes may be seen. To check exactly what is happening, turn on GLITCH DETECTion to capture any fast transients that may occur.

4. Press [SUB MENU].
5. Press [F4] to turn GLITCH DETECT on.

It may be necessary to adjust trigger level, range and time base manually.

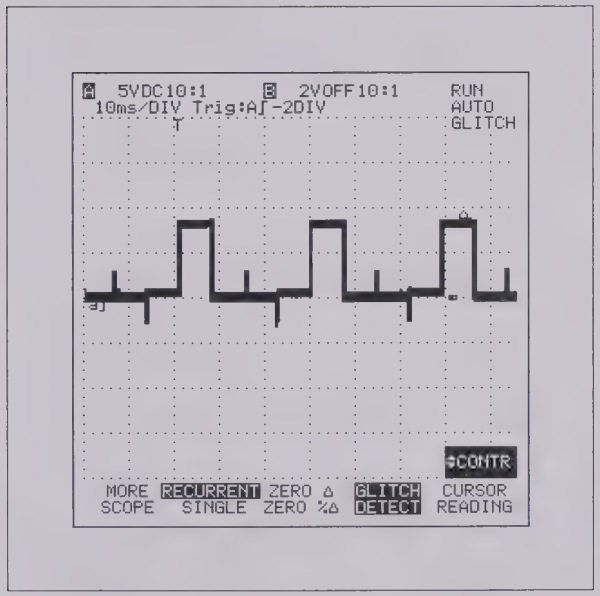



*Figure 8-15 Glitch Detection*

The glitches on this waveform are clearly visible on the trace, but what if the glitches are only intermittent and occur once a day. Watching the screen the whole day is not realistic, but for this purpose the Min Max envelope mode can be turned on. Min Max envelope retains all the samples on the display.

To turn on the Min Max envelope mode and only catch triggered data, do the following:

6. Press [MIN MAX].

You will then see the sample points build up on the screen. These points stay on the screen, even if the waveform disappears, for example, if you remove the scope probe.

### B. NOISE

Often waveforms have lots of noise superimposed upon them. Sometimes you need to measure the noise and sometimes you need to see the waveform through the noise. The Average feature helps in smoothing the random noise out of the waveform.

#### Connection

Connect the red scope probe from INPUT A to TP5 on the Demo Board.

#### Making the Measurement

1. Reset the ScopeMeter test tool ([F4] + [ON OFF]).
2. Press [F1] to select the SCOPE mode.
3. Press [AUTO SET].
4. Press [mV RANGE] on INPUT A to increase the amplitude to almost full screen.
5. Press [MOVE ▽] to position the waveform on the screen.

6. Press TIME ns to increase the time base speed to 5 ms/DIV.

Next set the trigger level close to the top of the positive slope of the waveform.

7. Press TRIGGER.

8. Press F2 to select +SLOPE.

9. Press ▲▼.

10. Use ▲ ▼ to highlight trigger level, and press F5 to select.

11. Use ▲ to adjust the trigger level close to the top of the waveform.

Continue with Zoom:

12. Use ◁ MOVE to position the middle of the leading (slow) edge on the fourth division of the display.

13. Press ▲▼.

14. Use ▲ ▼ to highlight "scope zoom", and press F5 to select.

15. Use ▲ to zoom in on the rising edge.

You should now see a slow rising edge across the screen that is noisy. Activate Min Max envelope for a couple of minutes to see the amplitude of the noise (see Figure 8-16).

16. Press MIN MAX to activate the Min Max envelope mode.

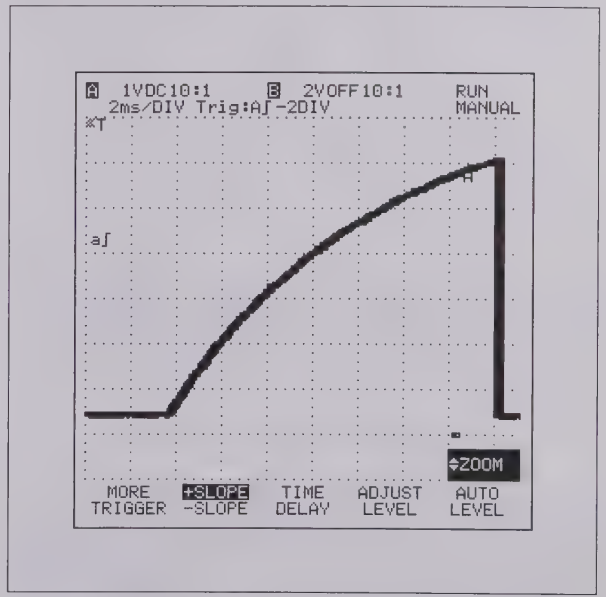



*Figure 8-16 Min Max Envelope*

Averaging can be used to remove this random noise from the waveform. The function will average a number of acquisitions and smooth out the random noise.

To use Average:

17. Press [MIN MAX] to disable Min Max envelope.

18. Press [▲▼].

19. Use △ ▽ to highlight "scope average", and press [F5] to select.

20. Use △ to achieve an average factor of 32.

You should now have a noise-free trace on the display as shown in Figure 8-17.

Note that Averaging slows down the waveform response. Don't forget to deactivate it if not required; otherwise, the display will appear sluggish.

21. Use ▽ to set Average to OFF

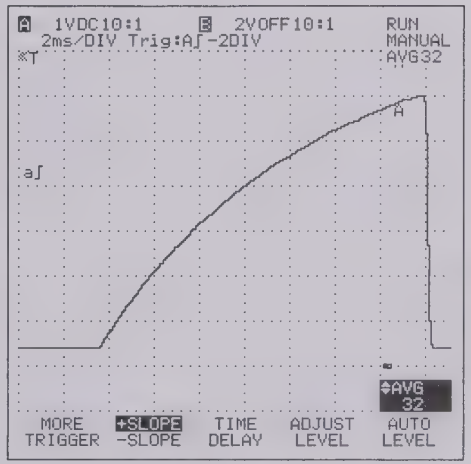



*Figure 8-17 Averaging a Waveform*

## MAKING SCOPE CURSOR MEASUREMENTS
~~91 92~~

Scope cursors can make measurements on 14 different waveform parameters, of which a maximum of five can be presented in the display. The definitions for each of these cursor measurements can be found in Chapter 6. Cursor measurements are made on the waveform contained between the cursors, so it is possible to measure just part of the waveform, such as the frequency of a burst rather than the main signal frequency.

### Connection

Connect the red scope probe from INPUT A to TP5 on the Demo Board.

### Making the Measurement

1. Reset the ScopeMeter test tool ([F4] + [ON OFF]).
2. Press [F1] to select the SCOPE mode.
3. Press [AUTO SET].
4. Press [s TIME] to slow the time base if required to show three cycles on the display.
5. Press [HOLD RUN] to freeze the display.

Freezing the display is not necessary when making cursor measurements, but for this example it gives stable values that are easier to examine.

### A. MAKING CURSOR AMPLITUDE (VOLTAGE) MEASUREMENTS

To select which Cursor measurements are to be made, you do the following:

6. Press [SUB MENU] to open the Scope mode Submenu.
7. Press [F1] to open the MORE SCOPE window.
8. Press [F4] for page 2.
9. Use ▽ to highlight CURSOR READINGS, and press [F5] to turn it on

Now you can choose the different cursor readings:

10. Use ▽ to highlight ADD MAIN READING, and press [F5] to open the list box.
12. Use △ ▽ to highlight V at left, and press [F5] to select.
12. Press [F5] to open the list box again for a next choice.
13. Use △ ▽ to highlight dV, and press [F5] to select.
14. Press [F1] to close the window.

15. Use [MOVE ▽] to shift the waveform downwards to fit completely on the display.

16. Use [◁ LEFT CURSOR ▷] and [◁ RIGHT CURSOR ▷] to horizontally position cursors as shown in Figure 8-18.

As you move the cursors left and right, their intersection with the waveform is indicated by a horizontal dotted line. Make sure that the left cursor is at the bottom of the waveform and the right cursor at the top (see Figure 8-18).

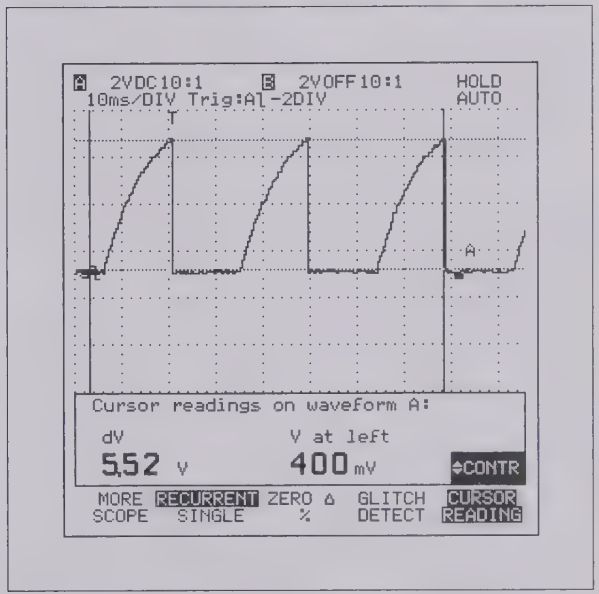



*Figure 8-18 Volt Cursors Measurement*

The voltage at the left cursor is about 400 mV. Remember that this waveform is DC coupled, so you are measuring the absolute DC value. Note that the ground is marked by the "⏚" indicator. To make absolute DC measurements, such as Vrms, Vmean, Vmax peak, Vmin peak, V at LEFT, or V at RIGHT, you must always use DC input coupling.

To make measurements referenced to certain waveform levels, first locate the cursors on the two levels (use the present positions):

15. Press [F3] and you will see that "ZERO Δ" is activated (highlighted).

The dV readout now changes to 0.00 ΔV. Move the left cursor to the right:

16. Press [◁ LEFT CURSOR ▷] until it is about halfway up the slope.

You should have the same value for both cursor readouts because the absolute voltage change is the same for both functions. To see this as a % change:

17. Press [F3] and "%" is activated (highlighted).

The dV readout is about 50% because you moved the left cursor halfway up the slope. Its reference points were the top and bottom of the slope.

## B. MAKING CURSOR TIME MEASUREMENTS

In addition to amplitude measurements you can also make time measurements.

1. Press [F3] once again to turn off "%".
2. Press [F1] to open the MORE SCOPE window.
3. Press [F4] for page 2.
4. Use ▽ to highlight ADD MAIN READING, and press [F5] to open the list box.

Choose the following two time readings:

5. Use △ ▽ to highlight "rise time", and press [F5] to select.
6. Press [F5] to open the list box once again.
7. Use ▽ to highlight "frequency", and press [F5] to select.
8. Press [F1] to close the window.
9. Use [LEFT CURSOR] and [RIGHT CURSOR] to locate the cursors as shown in Figure 8-19.

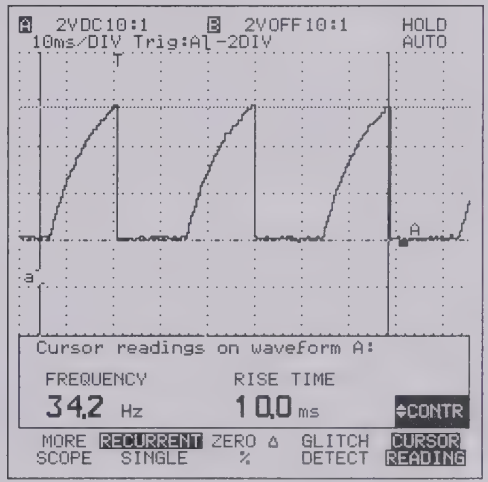



*Figure 8-19 Time Cursors Measurement*

The real frequency (Hz) measurement is an automatic measurement that occurs on the first full period contained between the cursors. If the cursors are too close together for a full period to be recognized, the test tool is unable to make a measurement and you see an answer of "---". To correct this situation move the right cursor more to the right. This frequency function makes simple measurements of sub-frequencies possible. Just move the left cursor to the start of the waveform detail you want to measure and read the frequency.

The rise time measurement also occurs on the first edge following the left cursor. You must set the left cursor at the waveform low level and the right cursor at the waveform high level. These two levels are used as the 0% and 100% references for this measurement. Rise time is defined as the time taken for the waveform to go from 10% to 90% of these two reference levels.

To see the markers:

1. Press F1 to open the MORE SCOPE window.
2. Press F4 twice for page 3 of the MORE SCOPE window.
3. Press F5 to open the SET MARKERS list box.
4. Use to highlight "rise time", and press F5 to select.
5. Press F1 to close the window.

You now have two 'X' markers on the leading edge of the waveform, which indicate where the 10% and 90% levels are. If you move the left cursor to the right, you see these markers move too.

To make a fall time measurement, you must set the left cursor at the high level and the right cursor at the low level.

### C. MAKING CURSOR PHASE MEASUREMENTS

In addition to the previous connection, also connect the grey scope probe from INPUT B to TP2.

1. Press [AUTO SET].
2. Use [RANGE V] [mV RANGE] of both inputs to see the two waveforms on the display.
3. Press [HOLD RUN] to freeze the display.

*(If the display shows glitches on INPUT B, press [HOLD RUN] twice more until they disappear; otherwise, incorrect measurements will be made).*

4. Press [F1] to open the MORE SCOPE window.
5. Press [F4] for page 2.

Now select the phase measurement as main reading:

6 Use ▽ to highlight ADD MAIN READING, and press [F5] to open the list box.

7. Use △ ▽ to highlight "phase A->B", and press [F5] to select.

You have now selected a phase measurement, but to see where it will actually occur it is best to activate the markers.

8. Press [F4] for page 3.
9. Press [F5] to open the SET MARKERS list box.
10. Use ▽ to highlight "phase", and press [F5] to select.
11. Press [F1] to close the window.

You should now have a display that looks like Figure 8-20.

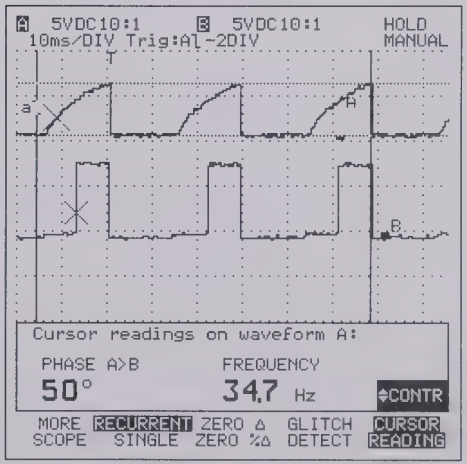



*Figure 8-20 Phase Measurement*

The phase measurement occurs at the mid-level of the rising edges of the two waveforms, beginning on the first edge after the left cursor. The source waveform (INPUT A) period is used as the 360-degree reference. For INPUT A the mid-level is clearly identified, but for INPUT B there was no sample made at the midpoint because of its sharp edge, so the marker is located on the closest sample point. Move the left cursor and the right cursor to the right and see how the markers position themselves to give either a phase leading (+) or a phase lagging (-) result.

If you want to make INPUT B the reference, do the following:

1. Press [F1] to open the MORE SCOPE window.
2. Press [F4] for page 2.
3. Use ▽ to highlight MEASURE on WAVEFORM, and press [F5] to open the list box.
4. Use ▽ to highlight "WAVEFORM B", and press [F5] to select.
5. Press [F1] to close the window.

Note that when you have a number of waveforms displayed you can simply change all the cursor measurements from one waveform to the next using MEASURE on WAVEFORM.

## USING THE MATH FUNCTIONS ~~91~~ ~~92~~ ~~96~~

ScopeMeter has a variety of math functions that enable you to extract more information from the waveforms than you can by just looking at them.

### Connection

Connect the red scope probe from INPUT A to TP3, and connect the grey scope probe from INPUT B to TP2 on the Demo Board.

### Making the Measurement

1. Reset the ScopeMeter test tool ([F4] + [ON/OFF]).
2. Press [F1] to select the SCOPE mode.
3. Use [s TIME ns] and [RANGE V] [mV RANGE] and [△ MOVE] [MOVE ▽] until you have a display as shown in Figure 8-21.
4. Press [HOLD/RUN] to freeze the waveform.

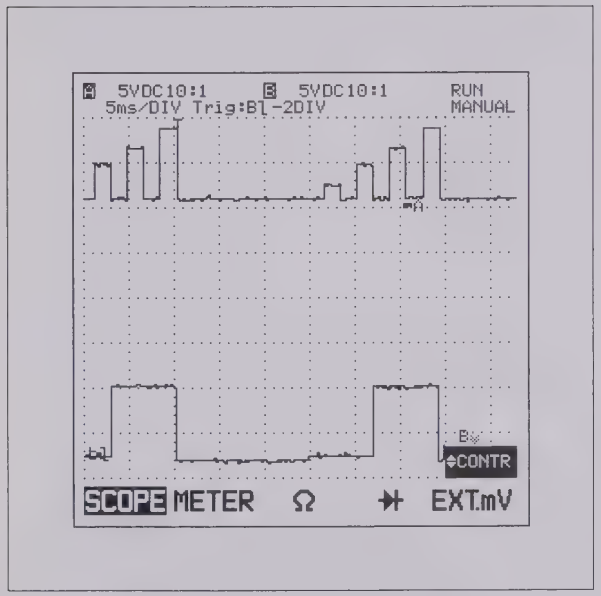



*Figure 8-21 Setup Display for Math*

Now you are ready to do math measurements:

5. Press [SPECIAL FUNCT] to open the Special Functions menu.
6. Press [F3] to open the MATH MENU window.
7. Press [F5] to turn MATH FUNCTION on.
8. Use ▽ to highlight MATH OPERATION, and press [F5] to open the list box.
9. Use △ ▽ to highlight "add", and press [F5] to select.

The Add, Subtract, and Multiply functions process information from two waveforms (or sources), and the result is placed in another waveform memory (or destination). To add INPUT A and INPUT B together and show the resulting waveform on the display, you need only to choose the destination of your choice.

10. Use ▽ to highlight SAVE IN DESTINATION, and press [F5] to open the list box.

The already highlighted destination is the first free Waveform memory location. Already filled memory locations are indicated with a closed square box in front of each item. But, you can always choose a memory to your preference.

11. Press [F2] to cancel
12. Press [F1] to close the window.

The result is stored in the first free memory location (memory 1), and is instantly displayed.

If you want to move the Math result on the display, do the following:

1. Press [◆].
2. Use ▲ ▼ to highlight "move 1", and press [F5] to select.
3. Use ▲ ▼ to move the Math result up and down on the display.

If the Memory #1 waveform amplitude needs adjustment:

4. Press [SPECIAL FUNCT].
5. Press [F3] to open the MATH MENU window.
6. Use ▲ ▼ to highlight SCALE RESULT, and press [F5] to open the list box.
7. Use ▲ ▼ for the appropriate scaling factor /5, and press [F5] to select.
8. Press [F1] to close the window.

You should now have a display as shown in Figure 8-22, where the sum of INPUT A and INPUT B is clearly visible.

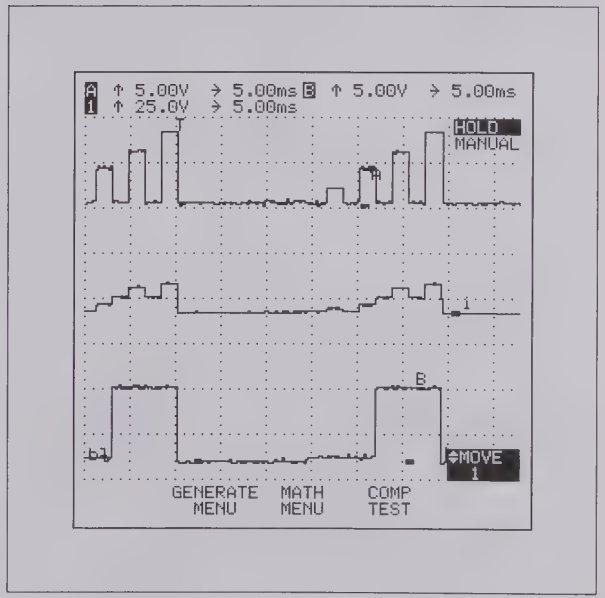



*Figure 8-22 Adding INPUT A + B*

Using the same procedure, you can perform subtraction or multiplication of two waveforms.

The Invert, Integrate and Filter functions process information from just one waveform (or source) and place the result in another Waveform memory (or destination). Invert is almost the same as the INPUT invert function found under the [INPUT A] or [INPUT B] menu. Integration allows you to totalize the waveform over a period of time, showing the real power dissipation when the waveform changes levels.

To use the Integrate function:

1. Press [SPECIAL FUNCT].
2. Press [F3] to open the MATH MENU window.
3. Use ▲ ▼ to highlight MATH OPERATION, and press [F5] to open the list box.
4. Use ▲ ▼ to highlight "integrate", and press [F5] to select.

INPUT A has a good waveform to demonstrate integration and Destination 1 is already displayed. If the resulting waveform amplitude needs adjustment:

5. Use ▲ ▼ to highlight SCALE RESULT, and press [F5] to open the list box.
6. Use ▲ ▼ for the appropriate scaling factor /25, and press [F5] to select.
7. Press [F1] to close the window.

With INPUT A set for DC coupling and the waveform varying from about 0 to +4V, the result of the Integrate function is a positive increasing line. When pulses occur on INPUT A, the integral result increases accordingly as shown in Figure 8-23. You can also use CURSOR READING to make measurements on the Math results.

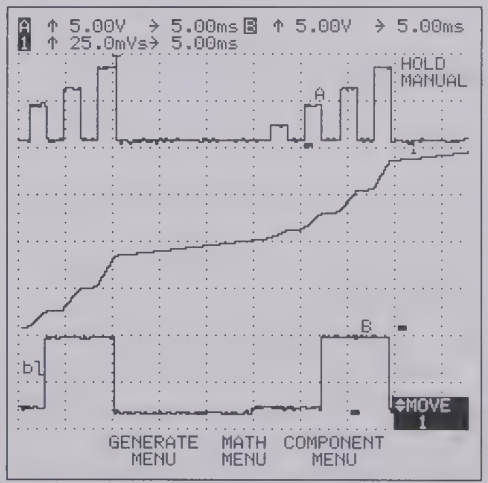



*Figure 8-23 Integration of INPUT A*

The Math Filter function averages the last five and the next five samples and removes high frequency noise from low frequency waveforms. Filtering is most useful to clean up single shot acquisitions.

To see the effect of the Filter function:

1. Press SPECIAL FUNCT.
2. Press F3 to open the MATH MENU window.
3. Use ▲ ▼ to highlight MATH OPERATION, and press F5 to open the list box.
4. Use ▲ ▼ to highlight "filter", and press F5 to select.

Next choose the INPUT B waveform as the source for the filter function:

5. Use ▼ to highlight SOURCE 1, and press F5 to open the list box.
6. Use ▼ to highlight WAVEFORM B, and press F5 to select.
7. Use ▲ ▼ to highlight SCALE RESULT, and press F5 to open the list box.
8. Use ▲ ▼ to turn scaling OFF, and press F5 to select.
9. Press F1 to close the window.

You now have a display as shown in Figure 8-24.

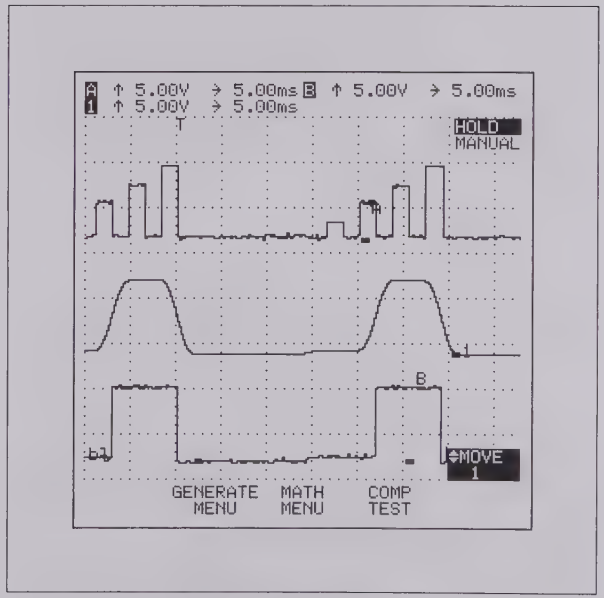



*Figure 8-24 Filtering INPUT B*

This completes the ScopeMeter Test Tool Tutorial.

At completion, be sure to disconnect the 9-volt battery on the Demo Board.

# Chapter 9
# User Maintenance


**CLEANING** . . . . . 9-2
**KEEPING BATTERIES IN OPTIMAL CONDITION** . . 9-2
**REPLACING AND DISPOSING OF BATTERIES** . . . 9-3
**REPLACING FUSES** . . . . . 9-5
**CALIBRATING THE PROBES** . . . . . 9-5
INPUT A Probe Calibration . . . . . 9-5
INPUT B Probe Calibration . . . . . 9-6

## ⚠ WARNING

**RISK OF ELECTRIC SHOCK OR FIRE:**
**USE ONLY INSULATED PROBES, TEST LEADS, AND CONNECTORS SPECIFIED IN THIS MANUAL WHEN MAKING MEASUREMENTS >42V PEAK (30V RMS) ABOVE EARTH GROUND OR ON CIRCUITS >4800 VA.**

**USE PROBES AND TEST LEADS WITHIN RATINGS AND INSPECT BEFORE USE.**
**REMOVE UNUSED PROBES AND TEST LEADS.**
**REMOVE PROBES AND TEST LEADS BEFORE OPENING CASE OR BATTERY COVER.**

**WHEN THE SCOPEMETER TEST TOOL IS CONNECTED TO ITS POWER ADAPTER/BATTERY CHARGER, TERMINALS MAY BE LIVE, AND THE OPENING OF COVERS OR REMOVAL OF PARTS (EXCEPT THOSE THAT CAN BE ACCESSED BY HAND) IS LIKELY TO EXPOSE LIVE PARTS.**

**THE TEST TOOL MUST BE DISCONNECTED FROM ALL VOLTAGE SOURCES BEFORE IT IS OPENED FOR ANY ADJUSTMENT, REPLACEMENT, MAINTENANCE, OR REPAIR.**

**CAPACITORS INSIDE MAY STILL BE CHARGED EVEN IF THE TEST TOOL HAS BEEN DISCONNECTED FROM ALL VOLTAGE SOURCES.**

## CLEANING

Clean the ScopeMeter test tool with a damp cloth and a mild detergent. Do not use abrasives, solvents, or alcohol.

## KEEPING BATTERIES IN OPTIMAL CONDITION

When new, the batteries typically provide 4 hours of use. To keep batteries in optimal condition, do the following:

Always operate the test tool on batteries until a blinking appears in the top right of the display. This indicates that the battery level is too low and the batteries need to be recharged.

### CAUTION

**Frequent charging of the batteries when they are not completely empty can cause a "memory effect". This means that the capacity of the NiCad batteries decrease, causing a decrease in the operating time of the test tool.**

You can revitalize a battery pack with too low capacity as follows:

1. Reset the ScopeMeter test tool (F4 + ON OFF), and ensure that the test tool is battery operated.

2. Press MIN MAX to activate the Meter Min Max recording mode.

This disables the battery save feature when no key entry is made for 5 minutes. Wait until the test tool is automatically turned off. When it is turned off, the batteries are completely discharged. Depending on the condition of the batteries, the discharging can last up to 8 hours.

3. When the test tool is turned off, connect the Power Adapter/Battery Charger PM8907 to the test tool and to local line power.

4. Charge for more than 16 hours.

5. Repeat steps 1 through 4 once more.

## REPLACING AND DISPOSING OF BATTERIES

**⚠ WARNING**

**TO AVOID ELECTRICAL SHOCK, REMOVE THE TEST LEADS, PROBES, AND BATTERY CHARGER BEFORE REPLACING THE BATTERIES.**

1. Disconnect the test leads, probes, and battery charger both at the source and at the ScopeMeter test tool.

2. Separate the test tool from its holster.

3. Locate the battery cover on the bottom rear. Loosen the two screws with a flat-blade screwdriver.

4. Lift the battery cover away from the test tool.

5. Remove the NiCad battery pack (or alkaline batteries, type KR27/50 or R14) from the battery compartment.

Ni-Cd *NOTE*

*This instrument contains a Nickel-Cadmium battery. Do not dispose of this battery with other solid waste. Used batteries should be disposed of by a qualified recycler or hazardous materials handler. Contact your authorized Fluke Service Center for recycling information.*

6. Install a new NiCad battery pack (PM9086/001) or new alkaline (C Cell) batteries (type KR27/50 or R14) as shown in Figure 9.1.

*NOTE*

*Ensure that the NiCad battery pack charging contact is aligned in the battery compartment as shown in Figure 9.1. Use only the PM9086/001 NiCad battery pack.*

7. Reinstall the battery cover and secure the two screws.

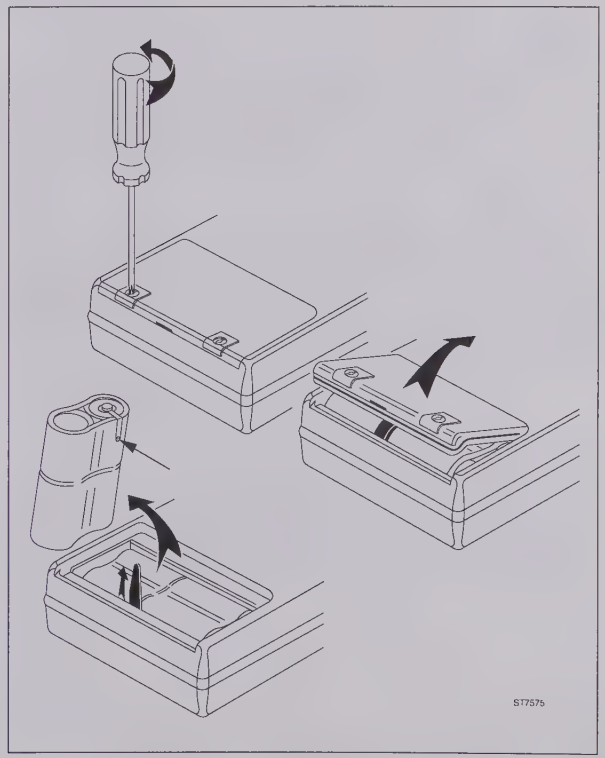



*Figure 9-1 Battery Replacement*

## REPLACING FUSES

Since the test tool uses electronically protected inputs, no fuses are required.

## CALIBRATING THE PROBES

The following procedures describe dc calibration and ac adjustment for the 10:1 probe used on INPUT A (red scope probe) and INPUT B (grey scope probe).

*NOTE*

*To meet full user specifications, use the 10:1 probes only with the inputs on which they have been calibrated.*

### INPUT A Probe Calibration

1. Connect the INPUT A BNC input to the GENERATOR OUT red banana jack. See Figure 9-2. Use the red scope probe and the red 4-mm banana adapter.
2. Turn the ScopeMeter test tool on.
3. Press [USER OPTIONS].
4. Press [F5] to open the PROBES MENU window.
5. Use ▲ ▼ to highlight PROBE on INPUT A, and press [F5]. This opens the list box.

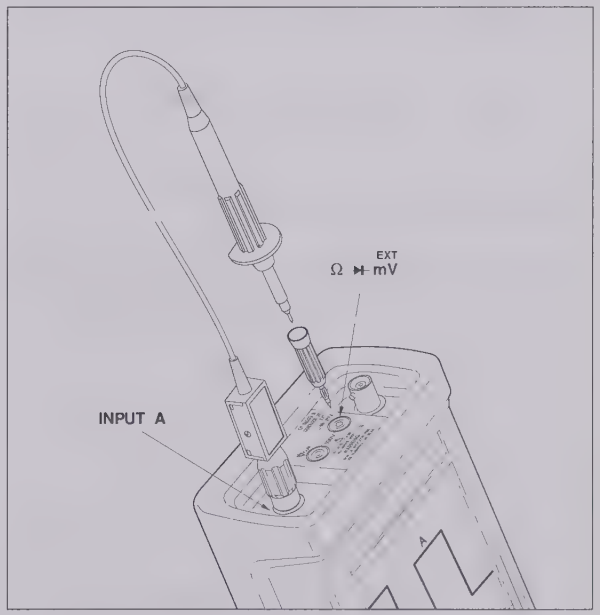



*Figure 9-2 INPUT A Probe Calibration Setup*

6. Use ▲ ▼ to highlight 10:1, and press [F5] to select.

7. Use ▼ to select CALIBRATE PROBE on A, and press [F5] to calibrate.

The test tool outputs a voltage on the GENERATOR OUT banana jack to the connected probe.

8. Adjust the trimmer screw in the probe housing of INPUT A to give an optimum square wave within the equal markers on the display (see Figure 9-3).

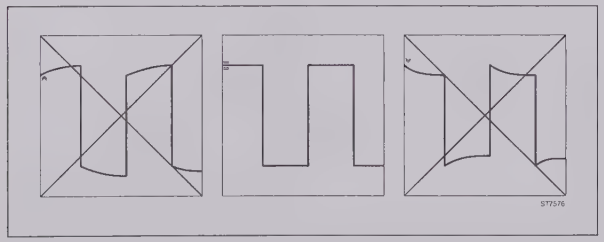



*Figure 9-3 Adjusting the Probe*

9. Press [F1] to continue.

The test tool automatically calibrates itself to the probe. A message appears on the display indicating that calibration is successfully completed.

10. Press [F1] to close the procedure.

**INPUT B Probe Calibration** ~~91~~

1. Connect the INPUT B BNC input to the GENERATOR OUT red banana jack. See Figure 9-4. Use the grey scope probe and the grey 4-mm banana adapter.

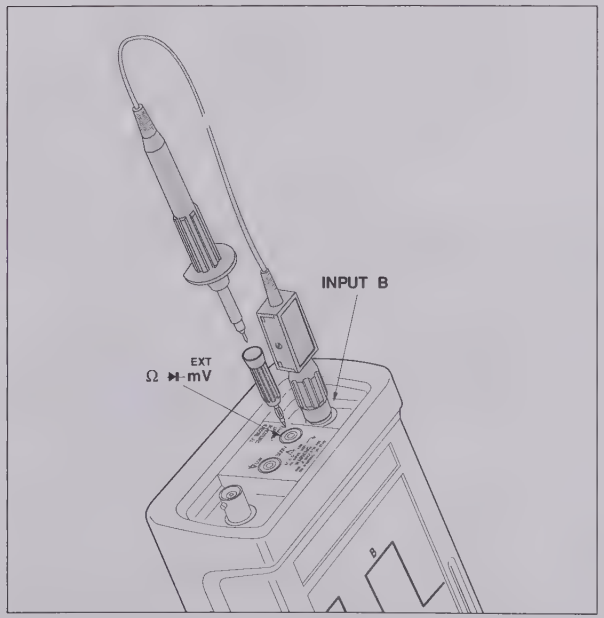



*Figure 9-4 INPUT B Probe Calibration Setup*

2. Repeat steps 2 trough 10 of the INPUT A calibration.

# Chapter 10
# Appendixes


10A Specifications . . . . . 10-3
10B Parts and Accesories . . . . . 10-11
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# Appendix 10A
# Specifications

## INTRODUCTION

### Performance Characteristics

FLUKE guarantees the properties expressed in numerical values with the stated tolerance. Specified non-tolerance numerical values indicate those that could be nominally expected from the mean of a range of identical ScopeMeter test tools.

For definitions of terms, refer to IEC Publication 351-1.

### Safety Characteristics

The ScopeMeter test tool has been designed and tested in accordance with IEC Publication 1010, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use. This manual contains information and warnings that must be followed by the user to ensure safe operation and to keep the instrument in a safe condition. Use of this equipment in a manner not specified by the manufacturer may impair protection provided by the equipment.

### Environmental Data

The environmental data mentioned in this manual are based on the results of the manufacturer's verification procedures.

## MEASURE MENU

The Measure menu gives direct access to over 30 measurements; the best operating mode is automatically selected.

## SCOPE MODE

### Continuous Auto Set

Hands-free signal probing. Continuously follows input signals from 15 Hz to 50 MHz and automatically selects the proper time base, input range, and trigger level.

### Min Max Envelope

Records the waveform excursions with a grey scale envelope on both inputs.

### 40 ns Glitch detect

Sweep speeds 1 µs per division or slower on INPUT A.

### Grey-scale display

Analog-like Grey-scale display.

### Waveform Average

Smoothing up to 256 waveforms. 10 samples in Roll mode.

### Vertical

Frequency Response, -3 dB ..... DC to >50 MHz
AC coupled ..... <10 Hz direct, <1 Hz with 10:1 probe
Coupling ..... AC, DC, Ground
Rise Time ..... <7 ns
Sensitivity ..... 1 mV to 100 V/div
to 1 kV/div with 10:1 probe
Current probe scaling ..... 1 mA/div to 100,000 A/div
Modes ..... A, -A, B, -B, A+B, A-B, A=x B=y
A, -A (FLUKE 91)
Input Impedance ..... 1 MΩ//25 pF direct,
10 MΩ//15 pF with 10:1 probe
Vertical Resolution ..... 8 bit (256 levels)
Accuracy ..... ±(2% +1 pixel),
add 3% for 1 and 2 mV/div

### Horizontal

Modes ..... Recurrent, Single Shot, Roll

RANGES:

Recurrent ..... 10 ns to 1 s/div
Dual input alternating ~~91~~ ..... 10 ns to 20 µs/div
Dual input chopped ~~91~~ ..... 50 µs to 1 s/div

Single Shot ..... 100 ns to 1 s/div
Dual input alternating ~~91~~ ..... 100 ns to 20 µs/div
Dual input chopped ~~91~~ ..... 50 µs to 1 s/div

Roll ..... 2 s to 60 s/div
Dual input chopped ~~91~~ ..... 2 s to 60 s/div

Accuracy ..... +(0.1% + 1 pixel)
Record Length ..... 256 or 512 samples (10 or 20 division)

**Trigger**

Sources..... A, B, or EXTernal
A, EXTernal (FLUKE 91)
Sensitivity: A or B.....<0.8 div to 10 MHz
<1.5 div to 60 MHz
<4.0 div to 100 MHz
Sensitivity: EXTernal .....+0.2V or 2.0V
(TTL level compatible)
External Input Impedance.....1 MΩ//25 pF direct,
10 MΩ//15 pF with 10:1 probe
Delay Time .....-20 to +640 div
N-cycle Trigger.....Retriggers after 2 to 255 trigger cycles
Delay by events .....1 to 1023 events after EXT trigger

**Cursor Measurements** ~~91~~ ~~92~~

Up to five displayed simultaneously. All voltage measurements can be ampere measurements with optional Current Probes.

Single cursor measurements:
V at LEFT, V at RIGHT, trig to LEFT, trig to RIGHT

Dual cursor measurements:
Hz, Vrms, VDC (mean), Vpeak/peak, V max peak, V min peak, rise time, phase, dV, dt, and 1/dt, frequency.

Measurement readout:
absolute, relative (zero), or % change.

Markers selectable on:
Hz, Vpeak/peak, V max peak, V min peak, rise time, and phase

**Waveform Mathematics** ~~91~~ ~~92~~ ~~96~~

Add, Subtract, Multiply, Invert, Filter, or Integrate input waveforms.
Calculate instantaneous or mean (real) electrical watts with optional Current Probes.

**Zoom**

Magnifies waveform around the fourth division at the next acquisition (sweep).

## METER MODE

Displays up to four readings and a full screen scope waveform of INPUT A.

**DC Voltage**

Ranges
direct input..... 100 mV, 300 mV, 1V, 3V, 10V, 30V, 100V, 300V
with 10:1 probe..... 1V, 3V, 10V, 30V, 100V, 300V, 1 kV, 3 kV (limit 600V)
Accuracy .....±(0.5% +5 counts)
Full Scale Reading.....1000 or 3000 counts
Normal Mode Rejection ..... >50 dB at 50 or 60 Hz
Common Mode Rejection .....>100 dB at DC, 50, 60, or 400 Hz

**AC or AC+DC True RMS Voltage**

Ranges
direct input .....100 mV, 300 mV, 1V, 3V, 10V, 30V, 100V, 250V
with 10:1 probe .....1V, 3V, 10V, 30V, 100V, 300V, 1 kV, 2.5 kV (limit 600V)

| | | |
|---|---|---|
| Accuracy ..... | 50 Hz to 60 Hz | ±(1% +10 counts) |
| (valid from | 20 Hz to 20 kHz | ±(2% +15 counts) |
| 5% range) | 5 Hz to 1 MHz | ±(3% +20 counts) |
| | DC to 5 MHz | ±(10% +25 counts) |

Full Scale Reading ..... 1000 or 3000 counts
Crest Factor .... Automatic ranging on crest factor overload
Common Mode Rejection Ratio.....>60 dB, DC to 60 Hz

**Additional Meter Mode Measurements**

FREQUENCY ..... 1 Hz to 5 MHz
Resolution.....4 digits
Accuracy .....±(0.5% +2 counts)

RPM .....selectable: 1 pulse/rev. or 1 pulse/2 rev.
Range.....60RPM (120 @ 1 pulse/2 rev.) to 99.99kRPM
Resolution..... 1 RPM (10RPM for RPM >10,000)
Accuracy .....±(1% +10 counts)

DUTY CYCLE ..... positive or negative pulse
Range.....2.0% to 98.0%
Resolution.....0.1%
Accuracy (logic or pulse waveforms) .....±(0.5% +2 counts)

PULSE WIDTH ..... positive or negative pulse.
Range..... 250 µs to 50 ms
Resolution..... 3 digits
Accuracy..... ±(0.5% +2 counts)

dBV ..... 1 volt reference

dBm ..... reference @ 50, 60, 75, 93, 110, 125, 135, 150, 250, 300, 500, 600, 800, 900, 1000 or 1200Ω

dBW or WATTS .....1, 2, 4, 8, 16 or 50Ω reference

## Ω MODE
(external 4-mm banana jack inputs)

Ranges ..... 30Ω, 300Ω, 3 kΩ, 30 kΩ, 300 kΩ, 3 MΩ, 30 MΩ
Accuracy (300Ω to 30 MΩ)..... ±(0.5% +5 counts)
Accuracy (30Ω) ..... ±(2.5% +25 counts)
Full Scale Reading..... 3000 counts
Measurement Current.....500 µA, 500 µA, 70 µA, 7 µA, 700 nA, 70 nA, 70 nA
Open Circuit Voltage..... <4V
Full Scale Voltage..... <250 mV to 3 MΩ, <2V to 30 MΩ
Continuity Beeper ..... audible for readings <5% of selected range

## DIODE TEST MODE
(external 4 mm banana jack inputs)

Open Circuit Voltage .....≤4V
Full Scale Voltage..... 2.800V
Measurement Current..... 0.5 mA
Continuity Beeper .....audible for readings <1V

## EXTERNAL mV MODE

Displays up to four readings and a full size waveform of the 4 mm banana jack input.

### DC Voltage

Ranges ..... 300 mV, 3V
Accuracy ..... ±(0.5% +5 counts)
Full Scale Reading ..... 3000 counts
Normal Mode Rejection ..... >50 dB at 50 or 60 Hz
Common Mode Rejection ..... >100 dB at DC, 50, 60, or 400 Hz

### AC or AC+DC True RMS Voltage

Ranges ..... 300 mV, 3V
Accuracy ..... DC and 1 Hz to 400 Hz
(valid from >5% of range) ±(2% +15 counts)
Full Scale Reading ..... 3000 counts
Crest Factor .... Automatic ranging on crest factor overload
Useful Bandwidth ..... 5kHz
Common Mode Rejection Ratio ..... >60 dB, DC to 60 Hz

### Additional EXTernal mV mode measurements

Frequency, RPM, Duty Cycle and Pulse Width measurements and waveforms can also be made with reduced accuracy.

°C / °F TEMPERATURE SCALING ..... for optional temperature probes
Scaling ..... 1 mV/degree

AMPERE SCALING ..... for optional current probes
Scaling ..... 1 mV/A, 10 mV/A, 100 mV/A, 1 V/A (1 mV/mA) for DC, AC rms, or AC+DC rms

## METER, Ω, DIODE, and EXTERNAL mV MODE FUNCTIONS

Smooth .... Moving average of readings for about last 8 sec.
Normal ..... <3.5 seconds response time for inputs >50 Hz
Fast ..... <1 second response time for inputs >50 Hz
Change Alert™ ..... Audible beep when reading changes
Touch Hold® .... Audible beep & hold of last stable reading
Relative ..... Zeros present reading as a reference value
% Change ..... % change relative to a reference value
% Scale ..... % of user set 0% and 100% references
Min Max ..... Simultaneous display of present, maximum, minimum, and average values with time

### Min Max TrendPlot™

Logs minimum, maximum, and average readings to memory at full accuracy and displays all three as graphs. Uses automatic vertical scaling and horizontal time compression for hands-free recording from 120 seconds to 40 days full screen.

Minimum, maximum, and average full accuracy (16 bit) waveforms available to PC interface ~~91~~ ~~92~~ ~~96~~.

## MEMORIES (SAVE OR RECALL ) ~~91~~ ~~92~~

Screen ..... all displayed waveforms, readings, and setup, 10 for Fluke 99, 5 for Fluke 96
Waveforms ..... individual waveforms with setting, 20 for Fluke 99, 10 for Fluke 96
Setups ..... complete test tool setting, 40 for Fluke 99, 20 for Fluke 96

## SIGNAL GENERATOR ~~91~~ ~~92~~ ~~96~~

Sine Wave ..... 1V pk-pk at 967 Hz
Source resistance ..... 400Ω
Square Wave .....5V pk-pk at 488 Hz, 976 Hz, or 1.95 kHz
Source resistance ..... 400Ω

## PROBE CALIBRATOR

AC probe adjust at 5pk-pk at 1.95 kHz

## COMPONENT TESTER ~~91~~ ~~92~~ ~~96~~

Current Mode..... 0 to +3 mA in max. 128 steps
Max. voltage..... ≤2V
Voltage Mode.....-2V to +2V in max. 128 steps
Max. Current ..... +or- 1 mA

## GENERAL SPECIFICATIONS

The accuracy of all measurements is within +(% of reading + number of counts) from 18 ˚C to 28 ˚C. Add 0.1 x (specific accuracy) for each ˚C <18 ˚C or >28 ˚C.

### Display

Super Twisted Liquid Crystal
Size.....84 x 84 mm (4.7" diagonal)
Resolution.....240 x 240 pixels, 25 pixels/div. in SCOPE mode
Contrast .....User adjustable
Backlight ..... Electroluminescent

### ⚠ Power

Internal Battery Pack .....NiCad 4.8V nominal
Operating Time.....Typical 4 hours
Power Adapter/Battery Charger
Charging Time .....Typical 16 hours
Alternate battery ..... 4 Alkaline C cells (nonrechargable)
External Supply .....8 to 20V DC, 5W typical via 5 mm jack

### ⚠ WARNING

**THE MINUS VOLTAGE IS CONNECTED TO COMMON. WHEN USING A POWER SUPPLY THAT IS NOT DOUBLE INSULATED, CONNECT COMMON TO PROTECTIVE GROUNDING.**

Memory back-up battery ~~91~~ ~~92~~ ..... CR2032
save screens, waveforms, and setups for up to three years after main batteries removed

**Environmental**

Temperature
Operating ..... 0 °C to 50 °C
Storage ..... -20 °C to 70 °C

Humidity
Operating ..... 20 °C to 30 °C, 90% RH noncondensing
30 °C to 50 °C, 70% RH noncondensing
Storage ..... 95% RH

Altitude
Operating ..... 3 km (10,000ft)
Storage ..... 12 km (40,000ft)

Shock and Vibration ..... per MIL-T-28800 for Class 3

Electromagnetic Interference ..... per MIL STD 461

**Mechanical**

Size excluding holster ..... 60 x 130m x 260 mm
(2.4 x 5.1 x 10.2 inches)
Size including holster ..... 65 x 140 x 275 mm
(2.5 x 5.5 x 10.8 inches)
Weight excluding holster ..... 1.5 kg (3.3 lbs)
Weight including holster ..... 1.8 kg (4.0 lbs)

**Safety**

Designed to Installation Category III per IEC 1010, CSA C22.2 (including approval), and UL1244 (including approval) for 600V measurements on industrial power distributions systems.

MAX. Input voltage on ..... 300V rms, 600V rms with
INPUT A or INPUT B 10:1 probe

MAX. Input voltage on EXTernal input ..... 300 V rms
Surge Protection ..... 4 kV, 6 kV with 10:1 probe
per IEC 664 and ANSI/IEEE C62.41 test method
Maximum Isolation to Earth .... 600V rms from any terminal
Optical Interface ..... Optically Isolated to 600V rms

## ACCESSORY INFORMATION

**Passive Probe 10:1 (PM8918)**

Attenuation: x10
Useful Bandwidth: 50 MHz
Input resistance: 10 MΩ
Input capacitance: 15 pF
Cable length: 2.5m
Max. signal Voltage: 600V rms
Max. surge Voltage: 6 kV
Max. Voltage to Ground: 600V rms
Double insulated per IEC1010-1 for 600V.

**Optically Isolated RS-232 Adapter /Cable (PM9080/001, optional)**

Serial Printer Interface ~~91~~ ~~92~~ ..... EPSON FX/LQ, HP Thinkjet, HP Laserjet
Print screens and waveforms or log meter and cursor readings

Full PC Interface ~~91~~ ~~92~~ ~~96~~ ..... Transfer setups, waveforms, measurements, etc.

Capture Screen ..... With optional FlukeView™ software

# Appendix 10B
# Parts and Accessories

## SERVICE MANUAL

Part Number: 4822 872 05361

## STANDARD KIT CONTENTS

| DESCRIPTION | MODEL | PART NUMBER | REMARK |
|---|---|---|---|
| Yellow Holster | PM9083/001 | --- | |
| NiCad Battery Pack (installed) | PM9086/001 | --- | |
| Power Adapter/Battery Charger (four models available:) | | | |
| Universal Europe 220V, 50 Hz | PM8907/001 | --- | |
| North America 110V, 60 Hz | PM8907/003 | --- | |
| United Kingdom 240V, 50 Hz | PM8907/004 | --- | |
| Universal 115V/230V | PM8907/008 | --- | |
| Accessory Case, Soft | C 75 | --- | |

| DESCRIPTION | MODEL | PART NUMBER | REMARK |
|---|---|---|---|
| Probe Set 10:1 | PM8918/002 | --- | set of two |
| 10:1 Probe (Red) | | 5322 210 70139 | |
| 10:1 Probe (Grey) | | 5322 210 70138 | |
| HF Adapter (2 x Black) | | 5322 263 50193 | |
| Adapter Probe Tip to Banana (Red) | | 5322 264 20096 | |
| Adapter Probe Tip to Banana (Grey) | | 5322 264 20097 | |
| High Voltage Test Pin (Red) | | 5322 264 20087 | |
| High Voltage Test Pin (Grey) | | 5322 264 20088 | |
| Mini Test Hook (Red) | | 5322 210 70131 | |
| Mini Test Hook (Grey) | | 5322 210 70129 | |
| Trim Screwdriver (Red) | | 5322 395 50417 | |
| Trim Screwdriver (Grey) | | 5322 395 50416 | |
| Industrial Alligator Clips (Red and Grey) | PM9084/001 | | set of two |
| Multimeter Test Lead Set | | 5322 310 32086 | set of two |
| Test Leads (Red and Black) | TL24 | --- | set of two |
| Test Pins (Red and Black) | TP20 | --- | set of two |
| Industrial Alligator Clip (Black) | AC20 | --- | |
| Banana Adapter (Red) | | 5322 264 20051 | |
| Banana Adapter (Black) | | 5322 264 20052 | |
| Adapter Dual Banana Plug to BNC | PM9081/001 | --- | |

| DESCRIPTION | MODEL | PART NUMBER | REMARK |
|---|---|---|---|
| Probe Accessory Set | | 5322 210 70149 | 91 |
| Adapter Dual Banana Plug to BNC | PM9081/001 | --- | |
| HF Adapter (2 x Black) | | 5322 263 50193 | |
| Adapter Probe Tip to Banana (Red) | | 5322 264 20096 | |
| High Voltage Test Pin (Red) | | 5322 264 20087 | |
| Mini Test Hook (Red) | | 5322 210 70131 | |
| Trim Screwdriver (Red) | | 5322 395 50417 | |
| Probe Accessory Set | PM9094/001 | --- | 92, 96, 99 |
| Adapter Dual Banana Plug to BNC | PM9081/001 | --- | |
| HF Adapter (2 x Black) | | 5322 263 50193 | |
| Adapter Probe Tip to Banana (Red) | | 5322 264 20096 | |
| Adapter Probe Tip to Banana (Grey) | | 5322 264 20097 | |
| High Voltage Test Pin (Red) | | 5322 264 20087 | |
| High Voltage Test Pin (Grey) | | 5322 264 20088 | |
| Mini Test Hook (Red) | | 5322 210 70131 | |
| Mini Test Hook (Grey) | | 5322 210 70129 | |
| Trim Screwdriver (Red) | | 5322 395 50417 | |
| Trim Screwdriver (Grey) | | 5322 395 50416 | |
| Demo Board | | 5322 216 51279 | |

| DESCRIPTION | MODEL | PART NUMBER | REMARK |
|---|---|---|---|
| Users Manual (English) | | 4822 872 00595 | |
| Users Manual (German) | | 4822 872 00596 | |
| Users Manual (French) | | 4822 872 00597 | |
| Users Manual (Dutch) | | 4822 872 00598 | |
| Users Manual (Spanish) | | 4822 872 00599 | |
| Users Manual (Italian) | | 4822 872 00601 | |
| Users Manual (Danish) | | 4822 872 00602 | |
| Users Manual (Norwegian) | | 4822 872 00603 | |
| Users Manual (Swedish) | | 4822 872 00604 | |
| Users Manual (Finnish) | | 4822 872 00605 | |
| Users Manual (Chinese) | | 4822 872 00613 | |
| Users Manual (Japanese) | | 4822 872 00614 | |
| Users Manual (Korean) | | 4822 872 00622 | |
| Quick Operating Guide | | 4822 872 00594 | |

# Appendix 10C
# PM8907 Information

Your ScopeMeter test tool is powered by a PM8907 Power Adapter /Battery Charger. The version you use depends on the configuration ordered.

**⚠ WARNING**

**TO AVOID ELECTRICAL SHOCK, CONNECT THE PM8907 POWER ADAPTER TO THE AC OUTLET BEFORE CONNECTION TO THE SCOPEMETER TEST TOOL.**

Four versions are used with the ScopeMeter test tool:

- PM8907/001 Universal European line plug 230V ±10%
- PM8907/003 North American line plug 110V ±15%
- PM8907/004 United Kingdom line plug 240V ±10%
- PM8907/008 North American line plug and switchable line voltage 115V ±15% or 230V ±15%.

The line frequencies for all units are 50, 60, and 400 Hz ±10%.

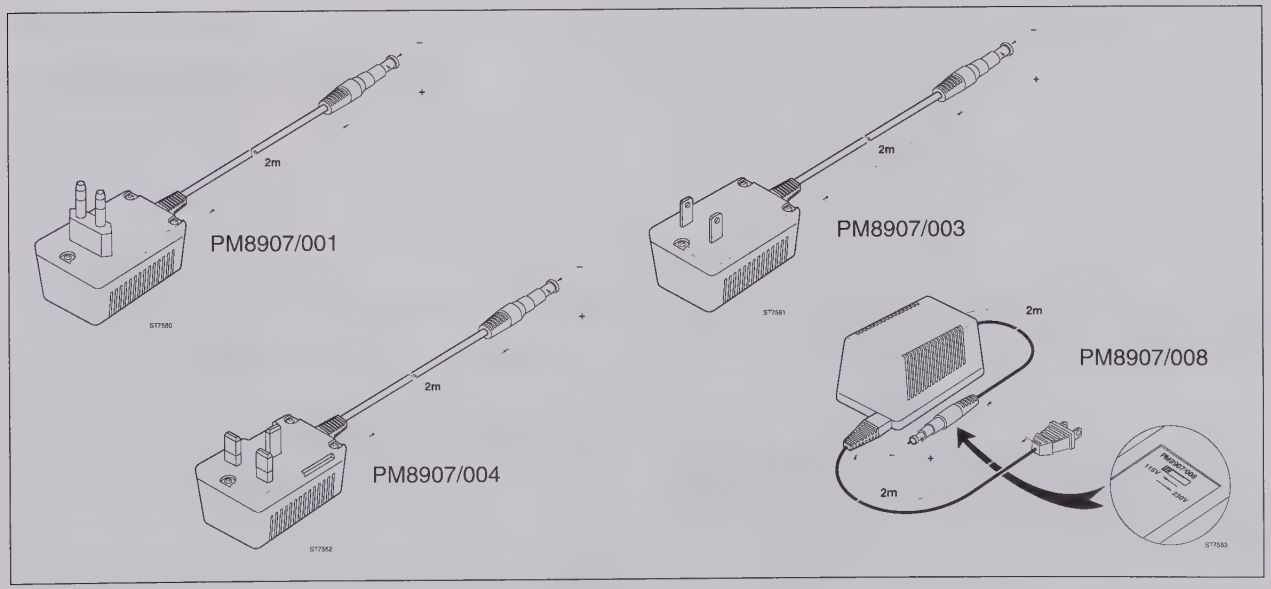


*Figure 10C-1 Four Versions of PM8907*

**CAUTION** **At delivery, the PM8907/008 is set to 230V and is provided with a Power Supply Cord and Attachment Plug that is for use at the 115V setting only. When operating the unit at the 230V setting, you need a North American-to-European line plug adapter.**

**Before you connect the PM8907/008 to the local line, first check the preselected voltage setting on this unit. You can find the voltage selector switch on the bottom of the PM8907/008. If necessary, select the corresponding line voltage with the slide switch and ensure that the proper voltage is visible in the window of the slide selector (see Figure 10C-1).**

# Appendix 10D
# Recommended Printer Setup Parameters

## EPSON FX/LQ COMPATIBLES

### Serial Interface Unit

| Switch | Function | Setting |
|---|---|---|
| 1-1 | Baud rate | OFF (1200 baud) or ON (9600 baud) |
| 1-3 | Baud rate | OFF (1200/9600 baud) |
| 1-4 | Baud rate | OFF (1200/9600 baud) |
| 1-7 | Baud rate | OFF (1200 baud) or ON (9600 baud) |
| 1-2 | Word length | OFF (8-bit) |
| 1-5 | Parity odd/even | don't care |
| 1-6 | Parity check | OFF (disabled) |
| 1-8 | Valid interface selection | ON (serial interface) |

### Main Unit

| Switch | Function | Setting |
|---|---|---|
| 1-1 | Print mode at power on | OFF (pica) |
| 1-2 | ZERO font | OFF |
| 1-3 | Paper-end detector | OFF (active) |
| 1-4 | Input buffer | ON (enabled) |
| 1-5 | Print mode at power on | OFF (normal) |
| 1-6 | International character set | ON |
| 1-7 | International character set | ON |
| 1-8 | International character set | OFF |
| | | |
| 2-1 | SLCT IN signal | ON (fixed) |
| 2-2 | Sheet feeder mode | OFF (deselect) |
| 2-3 | 1 inch skip-over-perforation | OFF (invalid) |
| 2-4 | Automatic line feed | OFF (LF from host) |

# HP THINKJET COMPATIBLES

## Mode switch

| Switch | Function | Setting |
|---|---|---|
| 1 | Mode select | DOWN (CR=CR) |
| 2 | Mode select | DOWN (LF=LF) |
| 3 | Perforation skip | DOWN (No) |
| 4 | Page length | DOWN (11 inch) or UP (12 inch) |
| 5 | Mode select | UP (alternate) |
| 6 | Character select | DOWN (Roman 8) |
| 7 | Character select | DOWN (Roman 8) |
| 8 | Character select | DOWN (Roman 8) |

## RS-232 switch

| Switch | Function | Setting |
|---|---|---|
| 1 | Handshake modes | DOWN (XON/XOFF) |
| 2 | Parity check/Data bits | DOWN (no parity/8 bits) |
| 3 | Parity check/Data bits | DOWN (no parity/8 bits) |
| 4 | Baud rate | DOWN (1200 baud) or UP (9600 baud) |
| 5 | Baud rate | DOWN (1200 baud) or UP (9600 baud) |

# Appendix 10E
# Warranty and Service Centers

## LIMITED WARRANTY & LIMITATION OF LIABILITY

Each Fluke product is warranted to be free from defects in material and workmanship under normal use and service. The warranty period is three years and begins on the date of shipment. Parts, product repairs and services are warranted for 90 days. This warranty extends only to the original buyer or end-user customer of a Fluke authorized reseller, and does not apply to fuses, disposable batteries or to any product which, in Fluke's opinion, has been misused, altered, neglected or damaged by accident or abnormal conditions of operation or handling. Fluke warrants that software will operate substantially in accordance with its functional specifications for 90 days and that it has been properly recorded on non-defective media. Fluke does not warrant that software will be error free or operate without interruption.

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# Appendix 10F Terminology

The following list defines special terms used in this manual. The terms are listed in alphabetical order. Words shown in *italics* can be found elsewhere in the list.

**AC** See "*Alternating Current.*"

**AC Coupling** A mode of signal transmission that passes the dynamic AC signal component to channnel A and channnel B but blocks the DC component. Useful to observe an AC signal that is normally riding on a DC signal.

**Alternating Current** An electrical signal in which current and voltage vary in a repeating pattern over time.

**Amplitude** The difference between the highest and lowest level of a *waveform.*

**Attenuation** The decrease in *amplitude* of a signal.

**Average** A processing technique to obtain the average value of a *repetitive* signal, useful to eliminate *noise.*

**Auto Set** Adjusts voltage scale and time base based on the characteristic of the active waveform, and automatically produces a stable *waveform* of usable size.

**Backlight** A light that brightens the *display*, useful for improving visibility in dark surroundings.

**Bandwidth** The range of *frequencies* that the ScopeMeter test tool can display accurately with no more than -3 dB (.7x) *attenuation* of the original signal.

**Battery Save** This feature enables the ScopeMeter test tool to shut itself down when running on batteries if the battery level is too low or if no key entries are made for 5 seconds.

**BNC** Coaxial-type input connector used for INPUT A and INPUT B ~~>91<~~.

**Bottom Display** The lower part of the *display*, where the *function key* menu is listed.

**Capture 10 Divisions** Records and displays 10 time divisions.

**Capture 20 Divisions** Records and displays 20 time divisions although the *display* shows only 10 at a time. Horizontal "Move" allows you to view the additional 10 divisions.

**Continuous Auto Set** Automatically selects the optimum settings for connected input signals and keeps track of any variation of the signal.

**Contrast** Contrast of the LCD. Can be adjusted as desired.

**Cursors** Movable display lines that allow you to make measurements between two locations on a *waveform*.

***dB*** *See "decibel."*

***DC*** *See "Direct Current."*

**DC Coupling** A mode of signal transmission that passes both AC and DC signal components to the INPUT A and INPUT B circuit (see also *AC Coupling*).

**Decibel** Measurements that indicate voltage or power comparison in a logaritmic scale.

**Delta %** Percentage change (delta) uses the present numerical reading as a relative reference. The display then shows a percentage that represents the difference between each new reading and the relative reference.

**Delay Time** The time between the trigger event and the real acquisition of the waveform.

**Delta Time (dt)** The change in time. The ScopeMeter test tool displays the amount of time displayed between the (vertical) *cursors*.

**Digital Storage Capability** Because of the design of digital oscilloscopes, signals are not displayed at the moment they are acquired. Instead, signals are first stored in memory, then sent to the *display.* This enables the ScopeMeter test tool to present several options when displaying information, including "negative delay."

**Direct Current** A signal with a constant voltage and current.

**Display** The Liquid Crystal Display area of the ScopeMeter test tool that is used to display all information, such as readings, *waveforms*, and text.

**Division** A part of a *waveform*, as defined alongside the lines of the grid on the *display*.

**Dual Trace** A feature that allows the ScopeMeter test tool to display two separate live *waveforms* at the same time ~~91~~.

**Duty Cycle** Ratio of a *waveform* with respect to the total *waveform* period, as measured in percent.

**Earth Ground** Reference point that is directly connected to the *ground* via a conductor.

**Envelope** The display of a *waveform* that shows the variation extremes of several acquisitions (see also *Min Max*).

**Events** Triggering via red 4-mm banana jack input (EXT) is delayed by a number of events that occur on INPUT A.

**Falling Slope** The part of a *waveform* that shows the voltage decreasing.

**Filter** Reduces or removes certain electrical components from a *waveform* (active input or memory). Is useful to suppress *noise* or to smooth a *waveform.*

**Free Run** Allows the ScopeMeter test tool to display a *waveform* without a *trigger.*

**Freeze** *Holds* a *waveform* acquisition: freezes the *display* for closer examination (see also Hold).

**Frequency** The number of times a *waveform* repeats in 1 second, measured in *Hertz* (Hz) where one Hz is one cycle per second.

**Function keys** The five blue keys along the top of the keypad. They change function based on the present mode or settings. Function key definitions appear in the *Bottom Display.*

**Glitch** A momentary spike in a *waveform.*

**Glitch Detect** Feature of ScopeMeter that increases its sampling rate to maximum so that *glitches* can be detected.

**GND** See "*Ground level.*"

**Ground level** The voltage reference point in a circuit. It is indicated with "-" on the display.

**Hard Copy** A copy on paper of the *display*, made by a printer via the optical RS-232 interface.

**Hertz (Hz)** Unit of measure to count the number of times that an electrical cycle repeats every second. One Hertz is one cycle per second.

**Hold** Allows you to *freeze* the *display* for closer examination.

**Identifications** Display markers for a better identification of all displayed waveforms, trigger level, delay, or slope, and ground level.

**Input Coupling** Modes of signal transmission for INPUT A and INPUT B: AC coupling, DC coupling, and GND (Scope only).

**Input selection** Select if and how the INPUTS A and B are displayed in Scope mode. This can be normal display, inverted display, or neither.

**Interface** Isolated optical to RS-232 Interface port for printer output (all models) and computer interfacing (FLUKE 99).

**Liquid Crystal Display (LCD)** A *display* that uses liquid crystals to display *waveforms* and text on its screen.

**Main Display** The center *display* area that shows measurement results or displays the *waveform(s)*.

**Marker** Identifies the point on the waveform on which a measurement has occurred or is expected to occur. The marker appears as an "X".

**Master Reset** Procedure to restore the ScopeMeter test tool to a set of initial standard settings.

**Maximum Peak** The highest voltage value of a waveform.

**Menu** A list of choices on the *display* to select functions via the five *function keys*.

**Messages** On-line information for the user, provided in situations where there is a conflict.

**Meter Mode** In this setting, the ScopeMeter test tool works like a digital multimeter, presenting information in numerical readings, and with a reduced Scope *display*.

**Minimum Peak** The lowest voltage value of a *waveform*.

**Min Max Envelope** Scope mode feature that draws a new *trace* without erasing earlier traces (*envelope*). This allows you to capture momentary *glitches* without having to constantly monitor the signal.

**N-Cycle** Trigger function, the input signal is divided by N before a trigger occurs. This creates a stable picture for *waveforms* with a cyclic character.

**Noise** Extraneous electrical signal, mostly unwanted.

**Non-Repetitive Pulse** A random electrical *waveform*, with no specific pattern or frequency.

**Oscillations** The up-and-down peaks of a *waveform*. One oscillation consists of one complete up-peak and one complete down-peak.

**Oscilloscope** A device for viewing and diagnosing electrical signals such as *waveforms*.

**Peak-to-Peak** The highest and lowest voltage value of a *waveform*.

**Percentage of Pulse Width** The ratio of signal on-time to its total cycle time, as measured in percent.

**Probe Calibration** A procedure that adjusts the ScopeMeter test tool internally to compensate for resistance variations between probes.

**Probes** Measuring conductor that connects the ScopeMeter test tool to a circuit; specifically for use in the *BNC* jacks.

**Pulse** A *waveform* that increases from a constant value, then decreases to its original value.

**Pulse Trains** A repetitive series of pulses.

**Pulse Width** The duration from the beginning to the end of a signal's on-time or off-time.

**Range** The quantity between two points or levels.

**Recall** The function of loading a stored *Setup*, *Screen*, or *Waveform* back into the ScopeMeter test tool.

**Recurrent** The ScopeMeter test tool continuously (recurrently) updates the display. This gives a dynamic look at the *waveform* activity as it occurs.

**Repetitive Pulse** A signal with a regular pattern or *frequency*.

**Rise Time** The time between the 10% and 90% points of the first slope after the left cursor of a waveform.

**Rising Slope** The part of a *waveform* displaying a rise in voltage.

**Root Mean Square (RMS)** Conversion of AC voltages to the effective DC value.

**Roll** Visual log of a *waveform* activity that is useful when measuring lower frequency signals.

**RPM** Engine speed expressed in Revolutions Per Minute.

**Sample** A momentary reading taken from an input signal. The ScopeMeter test tool takes a series of samples to display a *waveform*.

**Sampling Rate** The number of readings taken from a signal every second. The ScopeMeter test tool can take up to 25,000,000 samples per second.

**Screen** The complete image of the *display*.

**Scope Mode** In this mode, the ScopeMeter test tool works like a digital *oscilloscope*.

**Setup** Series of adjustments necessary for the ScopeMeter test tool to display a *waveform* or reading.

**Sine Wave** A common curved *waveform* that is mathematically defined.

**Single Shot** Allows the ScopeMeter test tool to capture a single event.

**Smooth (Scope)** Averages multiple *samples* of a *waveform*. Useful to suppress noise without loss of *bandwidth*.

**Square Wave** A common *waveform* that consists of repeating square pulses.

**Sweep Speed** see "Time Base"

**Time Base** The time defined per horizontal division on the *display*, expressed in seconds per division.

**Time Delay** The time between the *trigger* event and the real acquisition of the *waveform*.

**Top Display** The upper edge of the *display*, where the ScopeMeter test tool lists probe calibration, voltage scale, *time base*, *input coupling*, and *trigger* information.

**Trace** The displayed *waveform* that shows the voltage variations of the input signal as a function of time.

**Trigger** Determines the beginning point of a *waveform*.

**Trigger Level** The voltage level that a waveform must reach before the ScopeMeter test tool will read in.

**Trigger Slope** The voltage direction necessary for the ScopeMeter test tool to begin its *trace*. A positive slope requires the voltage to rise as it crosses the *trigger level*. A negative slope requires the voltage to fall.

**Trigger Source** The signal that triggers the ScopeMeter test tool. This can be the *waveform* being viewed, or it can come from another *waveform*.

**Voltage Spike** A momentary increase or decrease in voltage (see also *Glitch*).

**Waveform** The pattern defined by an electrical signal.

**Window** A list of functions from which you can choose. You open a window with the F1-(MORE) function key. You close the window with the F1-(CLOSE) function key.

**Zoom** Displays a live *waveform* with increased time resolution, giving up to 1000x magnification.

# Appendix 10G
# Menu Map

This appendix contains a series of charts showing the menus of each individual direct (hard-) key. Menus are shown for the following keys:

Figure 10G-1 [SCOPE METER] - [F1] (SCOPE)
Figure 10G-2 [SCOPE METER] - [F2] (METER)
Figure 10G-3 [SCOPE METER] - [F3] (Ω)
Figure 10G-4 [SCOPE METER] - [F4] (⊣⊢)
Figure 10G-5 [SCOPE METER] - [F5] (EXT.mV)
Figure 10G-6 [MEASURE MENU]
Figure 10G-7 [INPUT A]
Figure 10G-8 [INPUT B]
Figure 10G-9 [TRIGGER]
Figure 10G-10 [SAVE]
Figure 10G-11 [RECALL]
Figure 10G-12 [USER OPTIONS]
Figure 10G-13 [SPECIAL FUNCT]
Figure 10G-14 [▲▼]
Figure 10G-15 [ⓘ]

*NOTE*

*Troughout this manual, an X trough a model number (~~91~~) indicates that the function being discussed does not apply to that specific model number.*

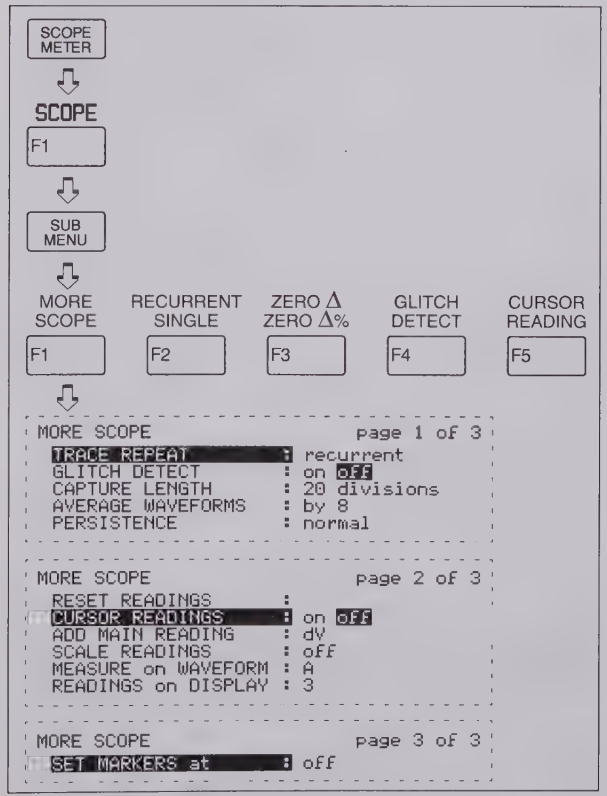



*Figure 10G-1 SCOPE menu*

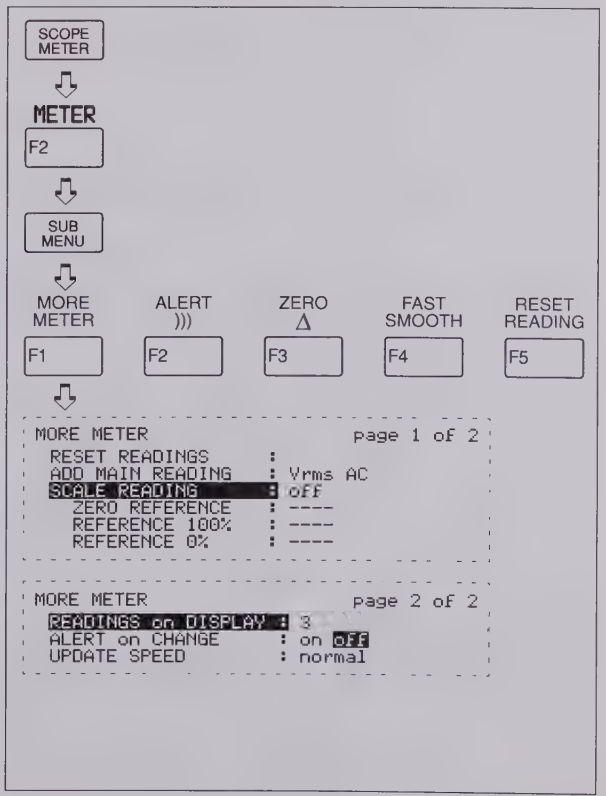



*Figure 10G-2 METER menu*

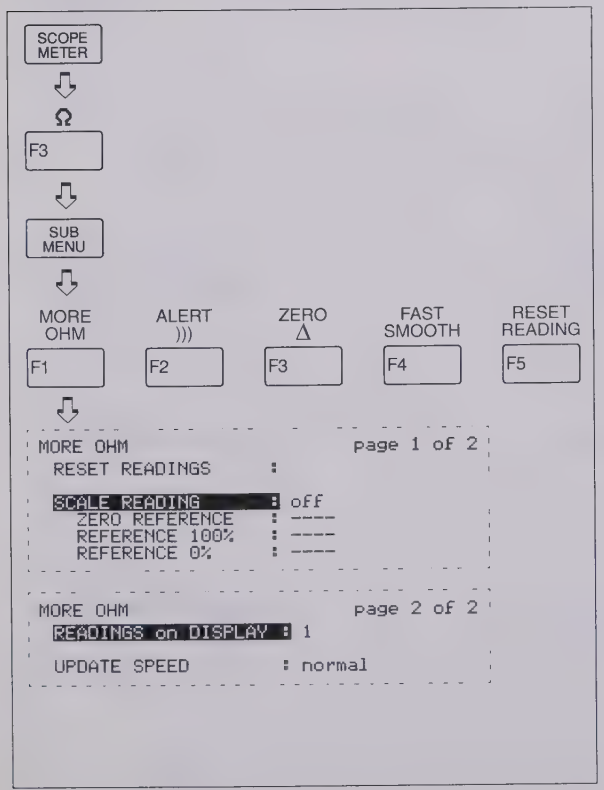



*Figure 10G-3 Ω menu*

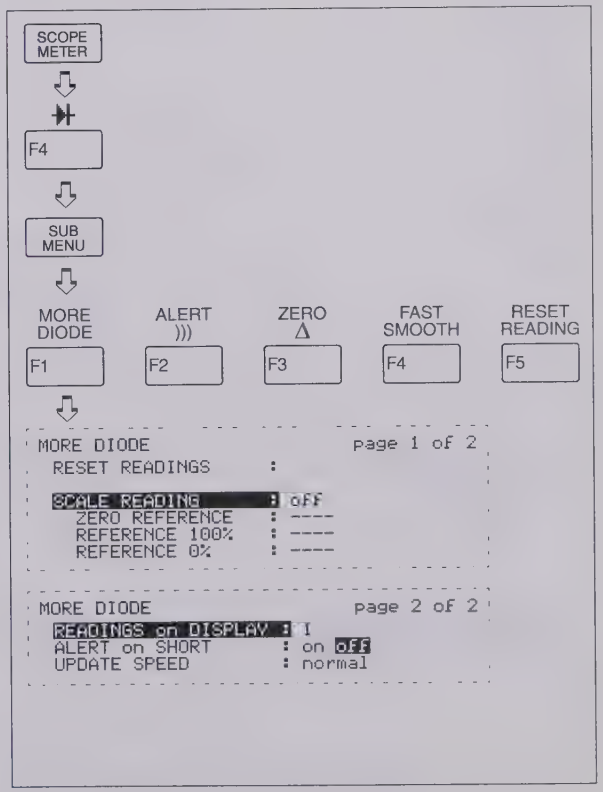



*Figure 10G-4 Menu*

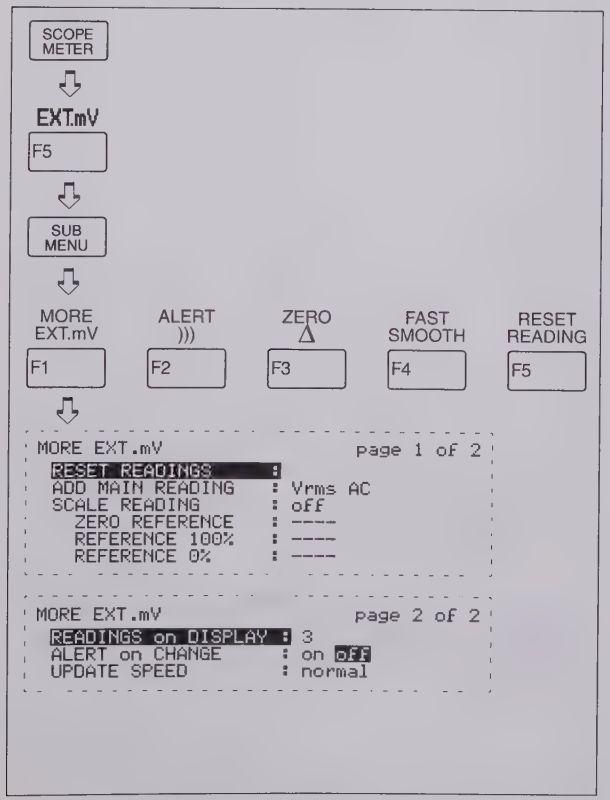



*Figure 10G-5 EXT.mV menu*

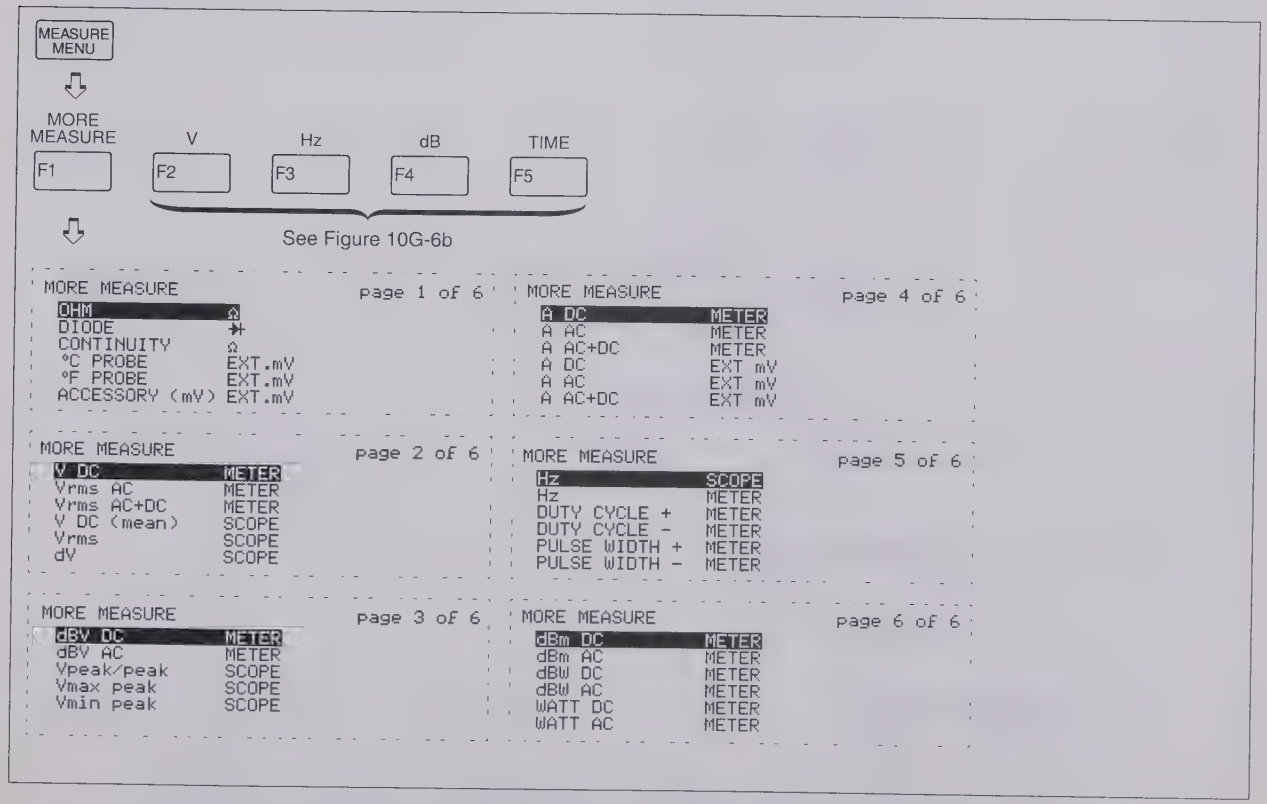



*Figure 10G-6a MEASURE menu*

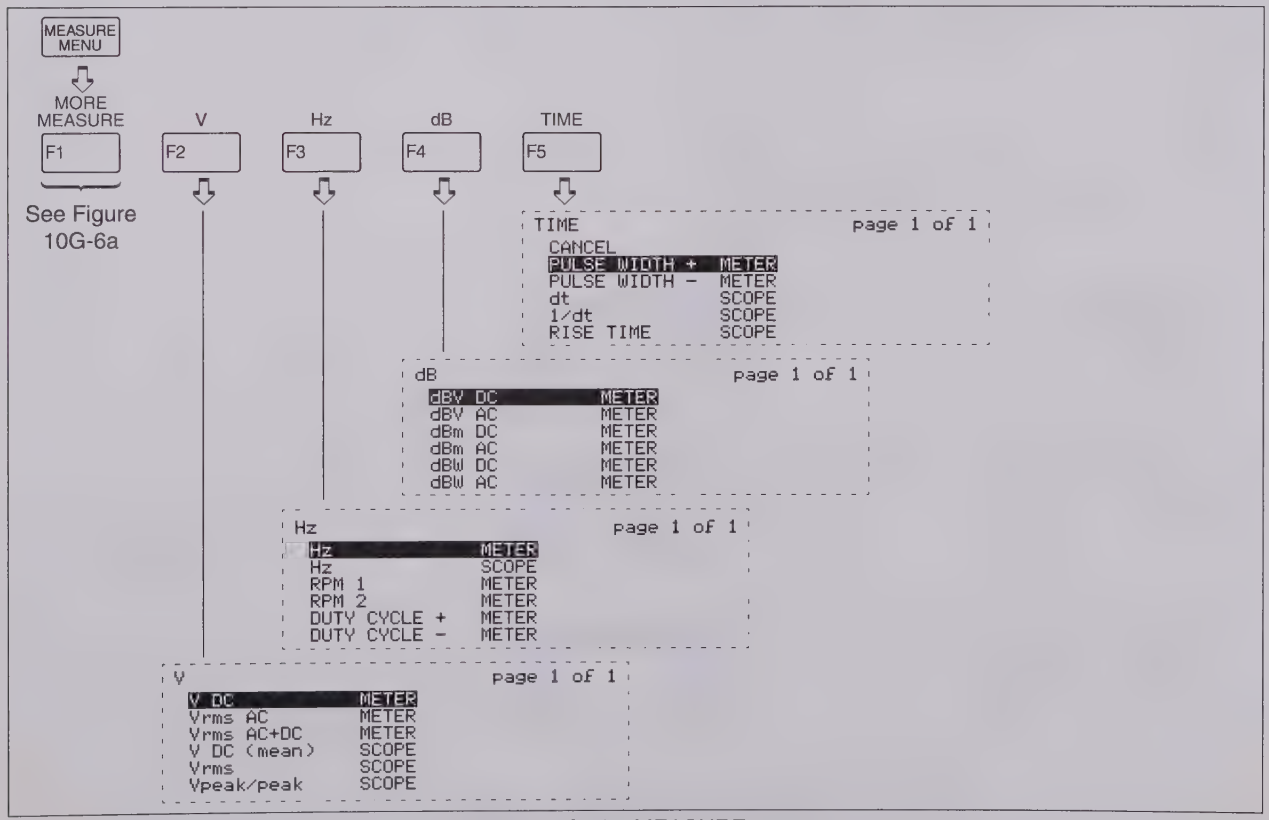



*Figure 10G-6b MEASURE menu*

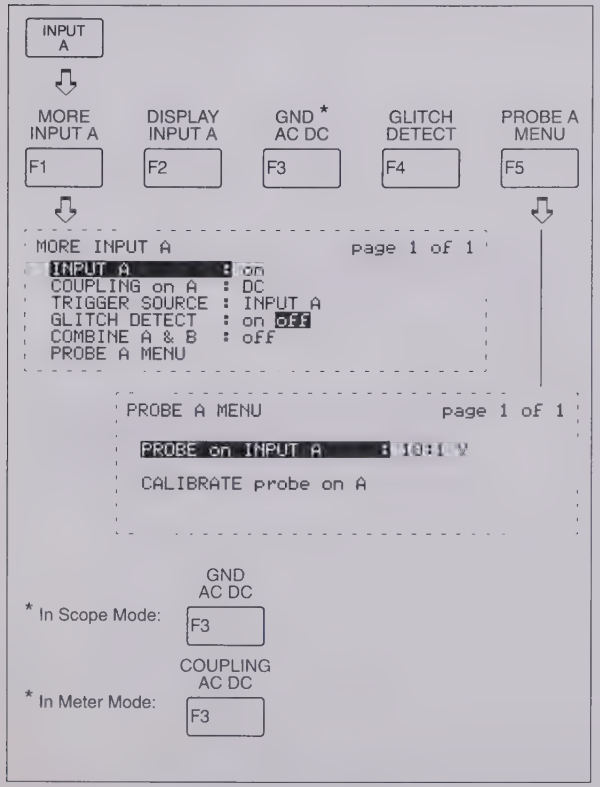



*Figure 10G-7 INPUT A menu*

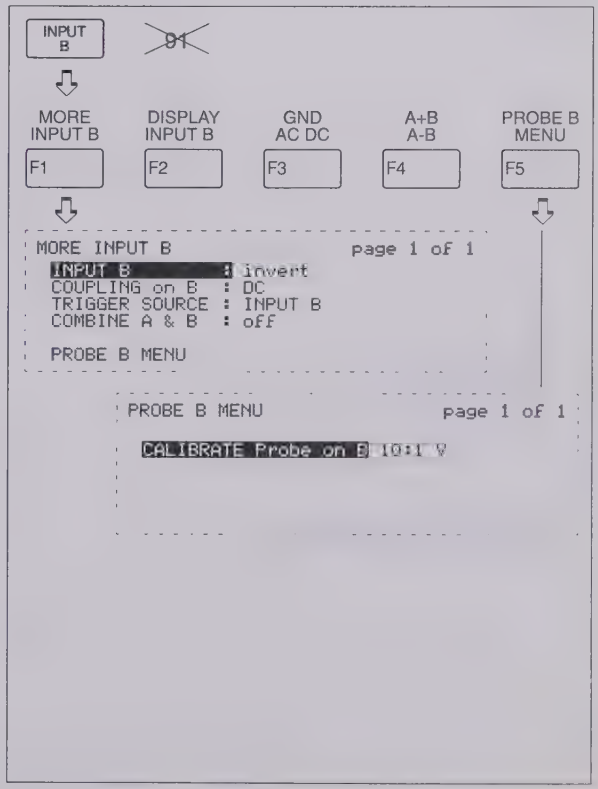



*Figure 10G-8 INPUT B menu*

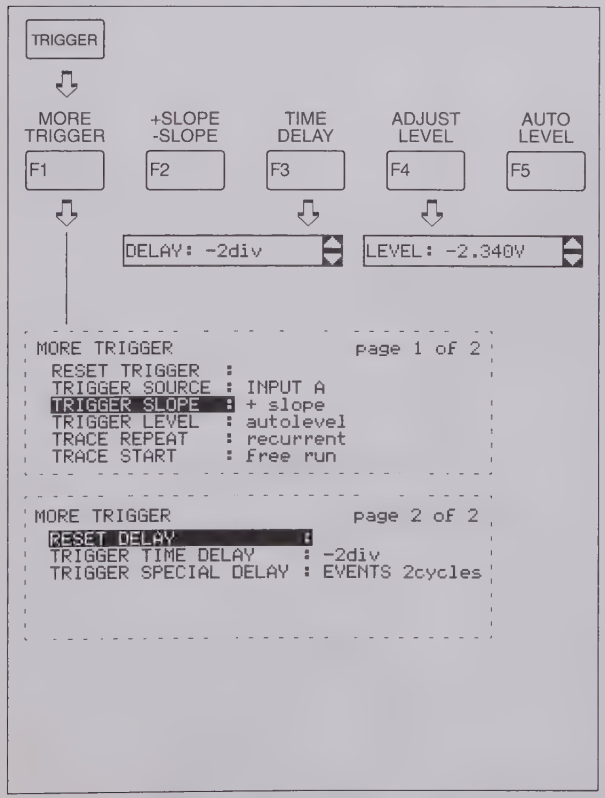



*Figure 10G-9 TRIGGER menu*

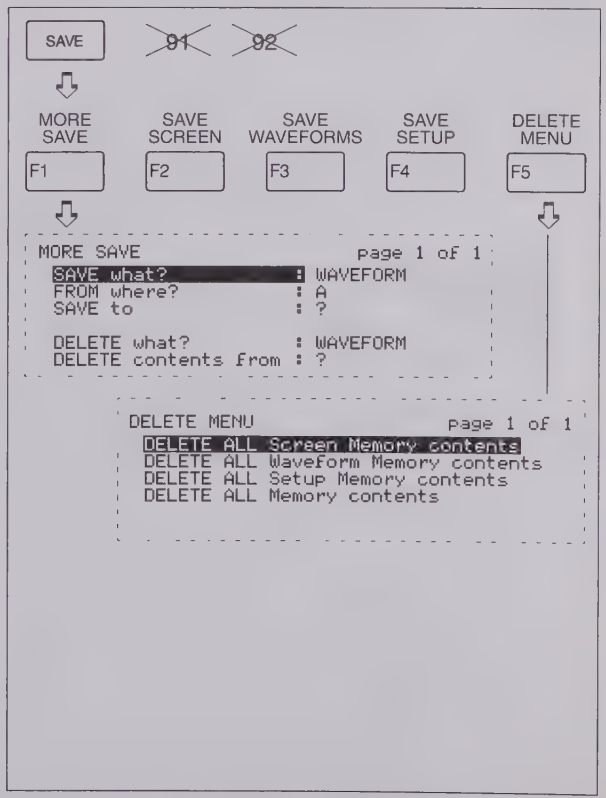



*Figure 10G-10 SAVE menu*

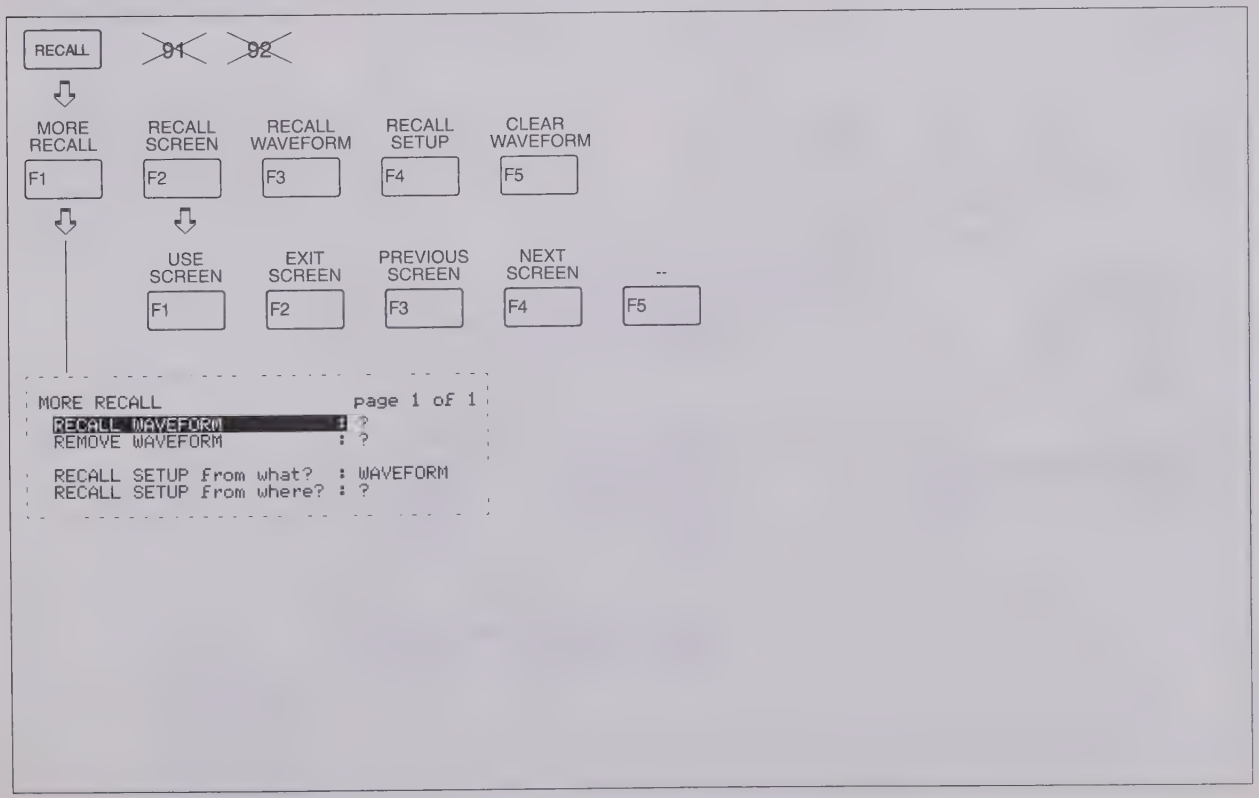
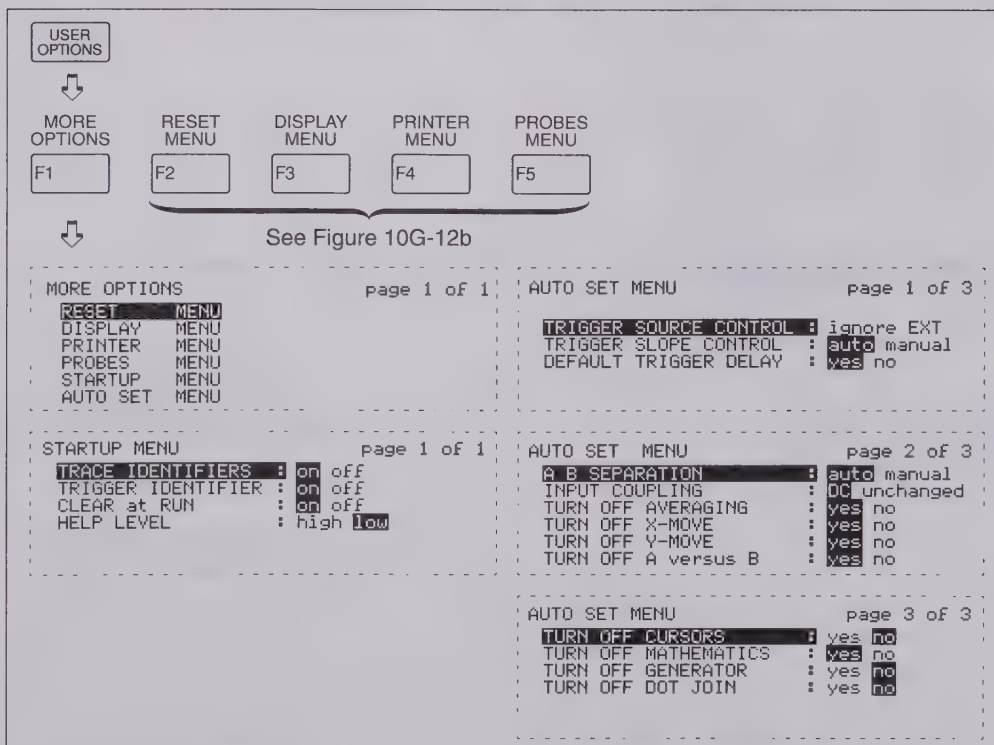



*Figure 10G-11 RECALL menu*


USER OPTIONS
MORE OPTIONS
RESET MENU
DISPLAY MENU
PRINTER MENU
PROBES MENU
F1
F2
F3
F4
F5
See Figure 10G-12b
MORE OPTIONS page 1 of 1
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DISPLAY MENU
PRINTER MENU
PROBES MENU
STARTUP MENU
AUTO SET MENU
AUTO SET MENU page 1 of 3
TRIGGER SOURCE CONTROL : ignore EXT
TRIGGER SLOPE CONTROL : auto manual
DEFAULT TRIGGER DELAY : yes no
STARTUP MENU page 1 of 1
TRACE IDENTIFIERS : on off
TRIGGER IDENTIFIER : on off
CLEAR at RUN : on off
HELP LEVEL : high low
AUTO SET MENU page 2 of 3
A B SEPARATION : auto manual
INPUT COUPLING : DC unchanged
TURN OFF AVERAGING : yes no
TURN OFF X-MOVE : yes no
TURN OFF Y-MOVE : yes no
TURN OFF A versus B : yes no
AUTO SET MENU page 3 of 3
TURN OFF CURSORS : yes no
TURN OFF MATHEMATICS : yes no
TURN OFF GENERATOR : yes no
TURN OFF DOT JOIN : yes no

*NOTE: For RESET menu, DISPLAY menu, PRINTER menu, and PROBES menu, see Figure 10G-12b*

*Figure 10G-12a USER OPTIONS menu*

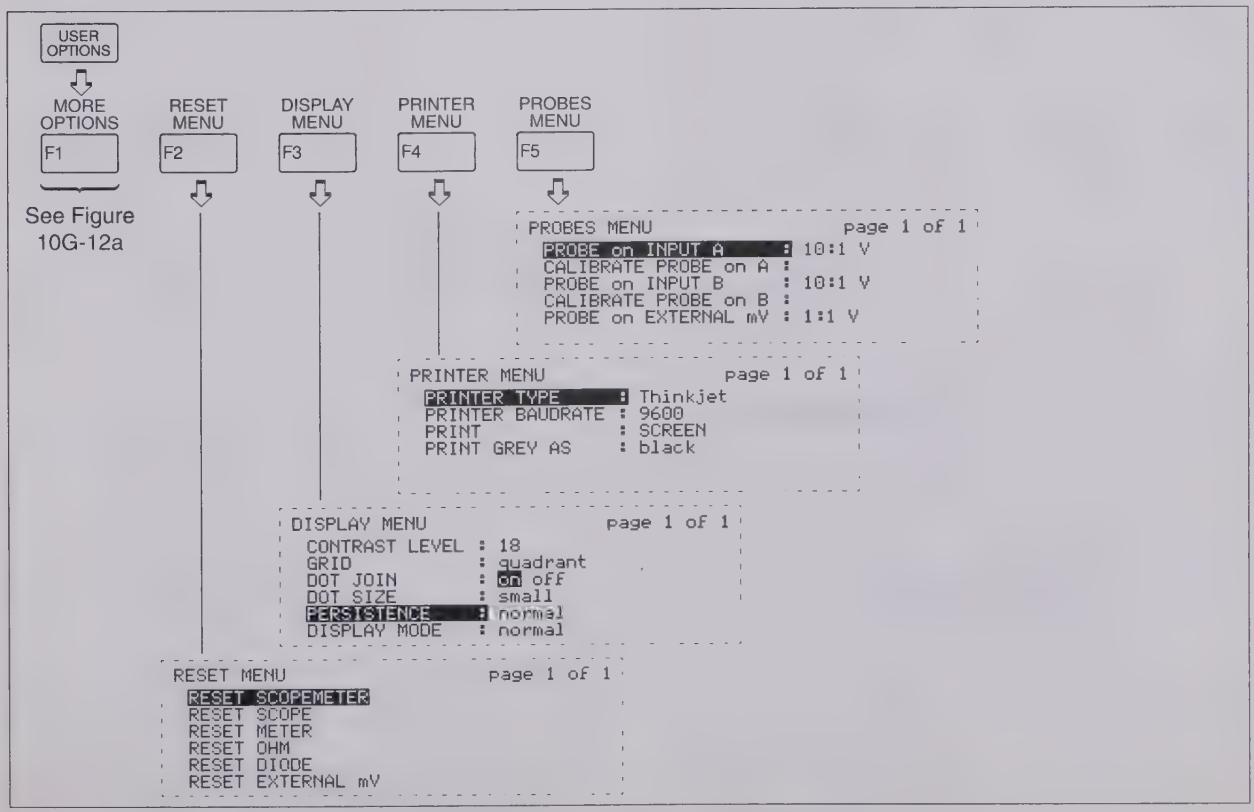


*Figure 10G-12b USER OPTIONS menu*

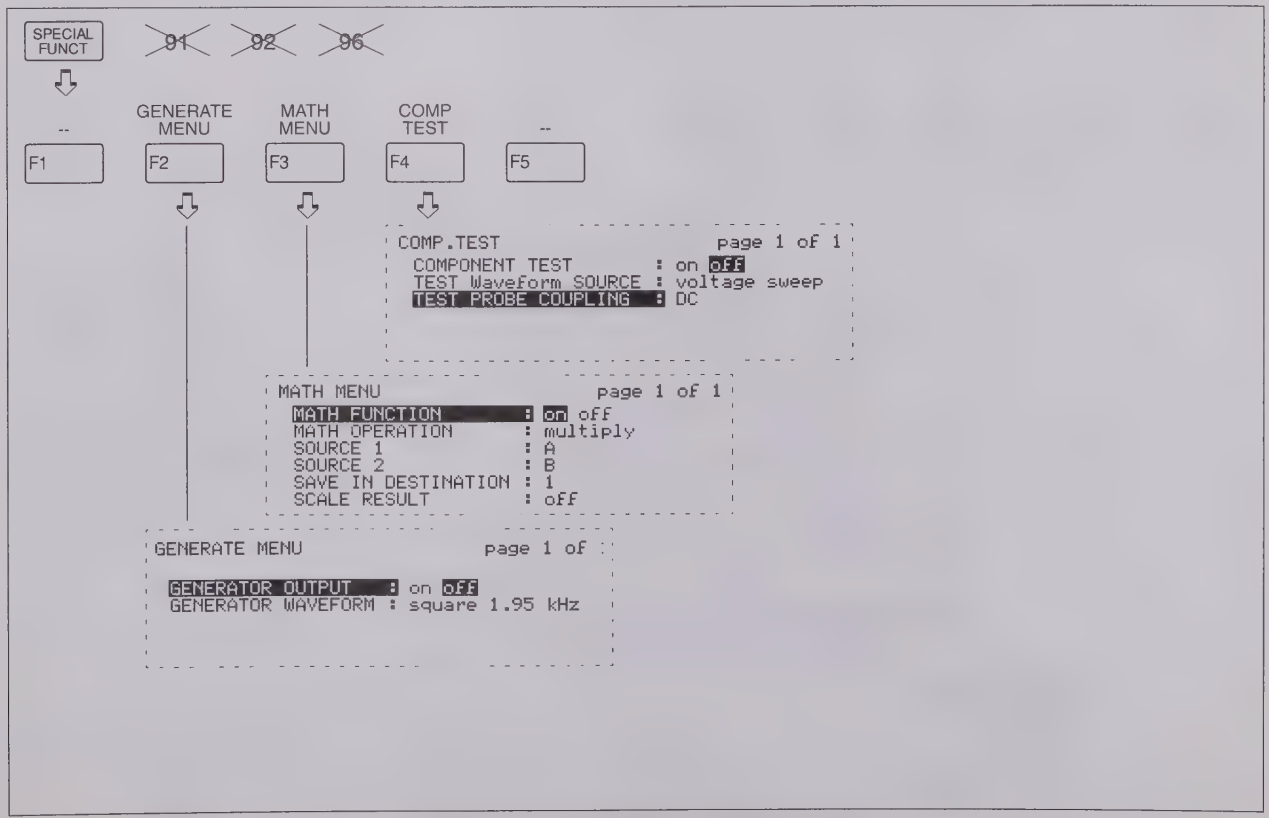


*Figure 10G-13 SPECIAL FUNCTION menu*

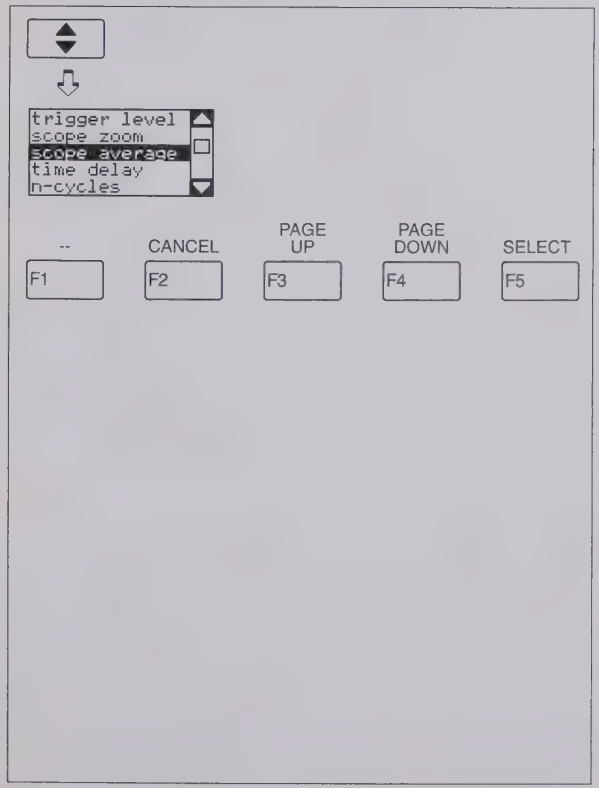


*Figure 10G-14* ⇕ *menu*

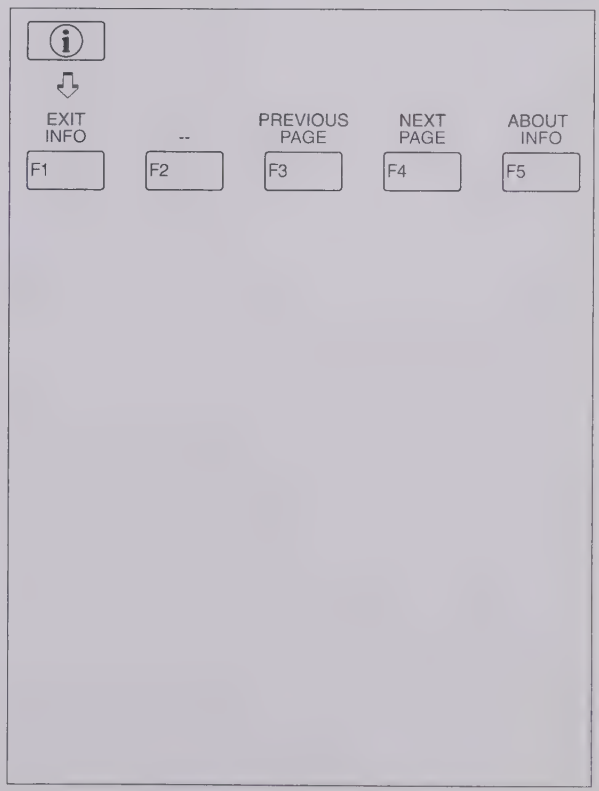


*Figure 10G-15 INFO menu*

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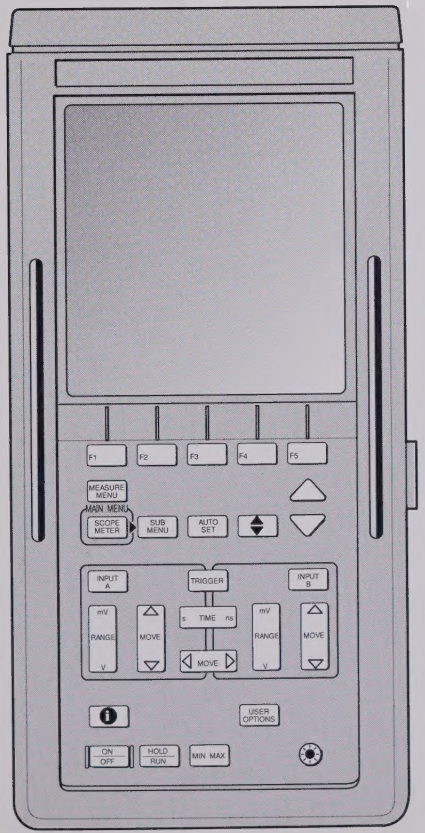
F1
F2
F3
F4
F5
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MAIN MENU
SCOPE METER
SUB MENU
AUTO SET
INPUT A
TRIGGER
INPUT B
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TIME
ns
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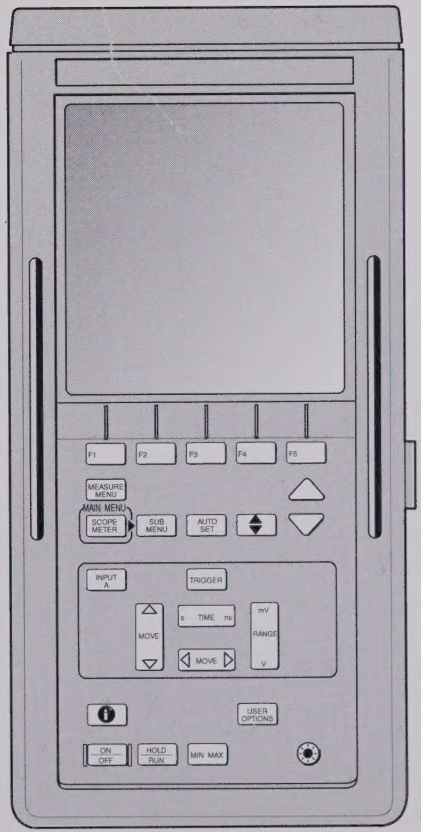
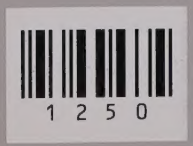
HOLD RUN
MIN MAX

91


F1
F2
F3
F4
F5
MEASURE MENU
MAIN MENU
SCOPE METER
SUB MENU
AUTO SET
INPUT A
TRIGGER
MOVE
s
TIME
ns
mV
RANGE
V
USER OPTIONS
ON OFF
HOLD RUN
MIN MAX

ST7589

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